ENGINEERING NEWS

A JOURNAL OF CIVIL, MECHANICAL, MINING AND ELECTRICAL ENGINEERING

Vol. 58. No. 8. 220 Broadway, New York, August 22, 1907.

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STONE BREAKWATER CONSTRUCTION AT HURON, OHIO.

By WILSON T. HOWE.*

The new east jetty or breakwater now in process of construction at Huron, Ohio, under the direction of Lt. Col. C. McD. Townsend, Corps of Engineers, U. S. A., is a good example of the modification that has taken place in stone breakwater construction in the last few years, and is also noteworthy on account of the departure by the contractor from the usual method followed in building this type of breakwater on the Great Lakes.

The change in the character of the interior filling and the paving is even greater than described in the article by Mr. Cushing in Engineering News of May 23, 1907.

This contract was let in April, 1906, by Lt. Col. Dan C. Kingman, Corps of Engineers, U. S. A., and the original specification reads as follows:

> When the depth is sufficient (five feet or more) the section of the jetty will be composed of two foundation ridges of quarry run stone, with crest at 5 ft. below mean lake level. The space between these ridges will be filled up with small riprap stone so as to leave room for a covering of large placed stone 7 ft. in thickness, finishing with a slope of 1 on 2 on the lake side and 1 on 1.5 on the harbor side. Where the depth is too small for this style of construction, the quarry run ridges will be omitted, using only the small riprap stone core and the large placed stone covering.
>
> The small riprap stone used for core filling will be free from slabs, dirt and rubbish and consist of pieces ranging from 1 lb. to 300 lbs. in weight.
>
> The quarry run stone will be composed of stone ranging from 200 lbs. to five tons, and the average weight of all the stones used shall not be less than 1½ tons; no stone will have a less thickness than one-third of its other greatest dimension.
>
> The large placed stone will be approximately rectangular in shape, with no angles sharper than 60° or more obtuse than 120°; the smallest dimension of any stone shall not be less than one-third its largest. The weight of individual stones may vary from four to eight tons.
>
> * * * * * * * The large placed stone will be set with derricks close and snug to each other, and on their best and largest bed, so that the distance between adjacent stones shall nowhere exceed 18 ins., and so as to break joints with each other and to tie the work together as well as the size and shape of the materials and existing conditions will allow. In finishing the slopes the stones shall be selected so that the finished surface will not vary 12 ins. from the desired outline.

As actually constructed, the small riprap filling is being omitted entirely (except as hereafter noted), the whole body of the jetty being composed of quarry run stone, whose average weight is not less than 1½ tons, no maximum limit being specified. The larger stones are deposited in the ridges and the smaller in the interior.

The large placed stone are being set as shown in the lower part of Fig. 1. The lower outside row on either side is set flat, the top of the stones being as near as practicable to mean lake level. The remainder of the covering of large placed stone is set edgewise, and preferably with the greatest dimension toward the interior of the work.

The accompanying view shows the character of the covering as far as built, and also indicates the method the contractor has adopted to carry on the work. Usually this work has been done with a floating plant, the stone being delivered by boat. Sometimes the stone has been delivered by rail, necessitating, however, the transfer of the stone from car to scows. The situation of this breakwater made it possible to handle the stone directly from the car into the work, its inner end being on shore, extending thence lakeward 1,800 ft. to a pierhead in 17 ft. of water.

METHOD OF CONSTRUCTING STONE BREAKWATER AT HURON, O.

The contractor, Hunkin Bros. Construction Co., of Cleveland, constructed a private yard for his cars of stone immediately at the shore end of the jetty and adjacent to the ore docks of the Wheeling & Lake Erie R. R., extending his main track out onto the work as it progressed. An Interstate Engineering Co., 8-wheel, locomotive crane, weighing 65 tons, and carrying an 80-ft. boom, handles all the stone, and at the beginning of the work did all the switching of cars. After reaching a distance of 700 ft. a small standard gage locomotive was obtained, as the time spent by the crane in switching was longer than it took to unload the stone.

Running out ahead of the car of stone, the crane throws in the quarry run stone, bringing it up about a foot above water surface for about 30 ft., or enough to lay a section of track, and only wide enough at top to insure safety for the crane. The top is then leveled up with small riprap to make a bed for the track stringers. Usually about 100 tons of small riprap is used for this purpose for each 30 ft. of track, there also being surplus enough of this to form a bed upon which to set placed stone. This 30-ft. section was laid in about eight days. The track is laid upon 12 × 12-in. stringers, carrying closely spaced cross-ties. The top of rail is at elevation of about 2½ ft. above mean lake level.

After a section of track is in place, the large placed stone are at once set, leaving the central space occupied by the track to be finished on the return to shore after the work has reached the pierhead. The large placed stone must weigh at least 4 tons, and may be as heavy as can be handled. Stones have been set as heavy as 14 tons, many have been 10 tons in weight, and the average is about 5 tons.

The average day's work for all kinds of stone is about 200 tons, working eight hours a day only, and the greatest amount handled in any one day to date is 454 tons, all quarry run stone. There is seldom delay caused by seas, as the quarry run stone is swung out and tripped by a line running from the stone hooks through a snatch block about half way up the boom, thence to a nigger-head on the engine. Sometimes the waves put the fire out under the boiler, but at such times it is usually possible to set placed stone on the harbor side nearer shore.

The work was begun in August, 1906, and continued all winter, there being placed to date, June, 1907, a total of 25,000 tons, the work being 1,000 ft. from the inner end. The estimated total is 63,500 tons. The working force ordinarily comprises a superintendent, foreman, engineer and fireman on crane, locomotive crew, and three laborers, but when unloading small riprap stone and laying track, from three to eight additional laborers are employed.

The contract price paid by the government for

*U. S. Junior Engineer, Huron, Ohio.

the stone in place is $1.30 for the small riprap and quarry run stone and $1.70 for the large placed stone.

Most of the stone is limestone from the quarries of the Bellevue Stone Co., at Bellevue, Ohio, distant about 26 miles by rail from Huron. A small amount has come from the sandstone quarries of the Independent Stone Co. at North Amherst, Ohio.

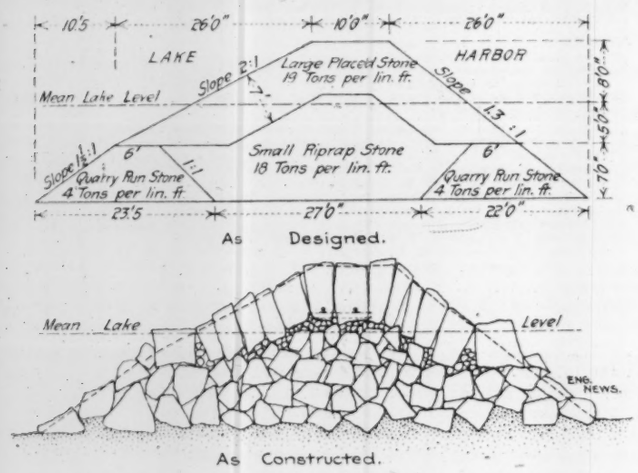


FIG. 1. JETTY AT HURON, O., AS DESIGNED AND AS BUILT.

AN UNLOADING MACHINE FOR DUMP CARS IN BUILDING EMBANKMENTS.

In building large and high embankments, as in railway construction, the usual practice is to build temporary trestles and deposit material from dump cars on the trestle. This involves considerable expense, especially where timber is not available, and an interesting unloader has been devised for rapidly dumping cars sideways at the head of the bank. This new method of unloading trains of dump cars was developed in connection with the construction of the Western Pacific Ry., where a number of high embankments had to be made. It was invented and patented by Mr. F. F. Lloyd, Chief Engineer for the E. B. & A. L. Stone Co., contractors, of Oakland, Cal., for the purpose of avoiding the expense of trestles or cableways, and it is reported to have proved very successful. We are indebted to Mr. Lloyd for plans and information. The general arrangement consists of a circular dumping track at the head of the bank, around which the cars are operated by a cable, and from which they are dumped. The general arrangement is clearly shown by the photograph reproduced in Fig. 1, and Fig. 2 shows one of the very heavy embankments being built with this device. Fig. 3 gives the details of construction, and Fig. 4 shows the arrangement of the track connections.

From the center of the unloader radiate large timbers which form a support for the circular track forming the end of the construction track from the steam-shovel pit. These timbers rest on iron rollers which are placed several feet apart, and ride upon wooden sills placed on top of the bank. At the center of the unloader is a mast, from the top of which lead iron rods supporting the outer ends of the radial timbers. Between the receiving and delivering sides of the circular track is a hoisting engine. From one drum on the engine cables passes around a main sheave and then around the track, between the rails, to a second drum. This cable and engine are used to haul the trains around the unloading track.

When a train of cars is brought to the unloader the engine is uncoupled and the train is quickly attached to the cable by a grip. It is then drawn around the track; the toggles on the cars are knocked loose, the cars dumped, righted, fastened and delivered to the waiting locomotive without having stopped. The only stop caused is for the attachment to the cable. The material can be dumped at any point, either inside or outside of the circular track, making it possible to carry the fill to a width of from 40 to 70 ft.

The force required about the unloader consists of a carpenter and three laborers. They attend to the moving, jacking up and blocking. To unload the trains requires an engineman and four laborers. When necessary, the unloader is moved forward on the rollers, 10 ft. at a time, by its own power. No time is lost because of moving, as this is done during a meal hour. Four 16-ft. timbers, one under each rail, and attached to the unloader, support the track until a train fills in the 10-ft. space left by the forward movement. The bottom of the unloader is 4 ft. below grade, but the first train after a move fills this hole to the grade level.

The unloader shown is the second of its kind. The first was used on a 125-ft. bank, while the one shown is making a 112-ft. bank. During several months of use the second machine has not once caused a delay, though it has been in use day and night. Its capacity for handling trains has not been determined, owing to its ability to dump trains so much faster than they could be loaded by a 70-ton shovel digging in excellent material. The dispatch with which it handles cars on the dump is one of the unloader's most favorable points. Other points that would make it attractive to contractors are stated as follows: 1, The very low cost of its construction, as compared to the usual trestle; 2, The shortness of time required to put it together (very little framing being necessary); 3, It can be readily taken apart when a job is completed, and used on many different jobs, as all parts are put together with bolts.

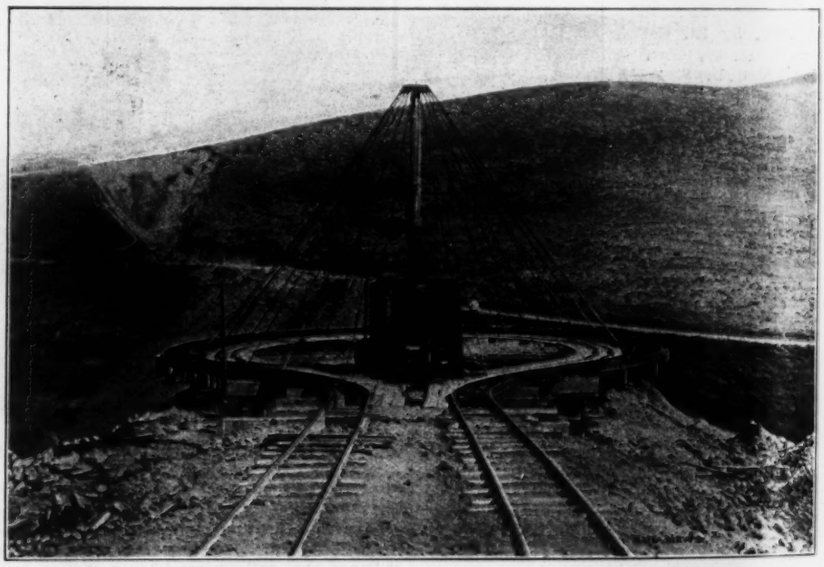


FIG. 1. CAR DUMP FOR BUILDING EMBANKMENTS ON THE WESTERN PACIFIC RY.
E. B. & A. L. Stone, Oakland, Cal., Contractors.

A RAILWAY LINE across the shallow waters separating India from Ceylon has been projected by Mr. H. W. Perry, District Traffic Superintendent of the South Indian Ry., with headquarters at Trichinopoly, India, and is described in a pamphlet issued by him. The total distance is about 22 miles, of which 7 miles is islands above tidewater, 4 miles is shallows less than 3 ft. deep, 6½ miles is less than 10 ft. deep, 6½ miles is 10 to 20 ft. deep and only a mile is over 20 ft. deep.

THE REVISED SANITARY CODE OF THE TOWN OF MONTCLAIR, N. J.

We reprint below the sanitary code of the town of Montclair, N. J., as finally revised early in April, 1907. Montclair is a suburb of New York, with a present population of about 17,000.

The Montclair Board of Health has always acted on the assumption that a large part of its work falls within the domain of sanitary engineering, and has made it a rule to employ a sanitary engineer as its chief executive health officer. The Montclair code has been evolved during the past dozen years, largely by the engineer-health-officers alluded to above. These have included, in chronological order, Mr. Theodore Horton, M. Am. Soc. C. E., now Consulting Engineer of the New York State Department of Health; Mr. Marshall O. Leighton, Assoc. M. Am. Soc. C. E., now Chief Hydrographer, U. S. Geological Survey; Mr. Horatio N. Parker, now an assistant to Mr. Leighton; and Mr. Chester H. Wells, the present incumbent. The Montclair Board consists of five members: two have always been chosen from the physicians of the town; two have generally been lawyers, but latterly there has been one lawyer and one business man; and, from the start, one has been an engineer.

Besides the health officer there are employed to aid in enforcing the sanitary code and in doing the other work of the board two sanitary inspectors and a chemist and bacteriologist. The health officer acts as registrar of vital statistics. The board has its own attorney. The code is as follows:

AN ORDINANCE ESTABLISHING A SANITARY CODE FOR THE TOWN OF MONTCLAIR.

The Board of Health of the Town of Montclair, in the County of Essex, by virtue of the provisions of the act of the Legislature of New Jersey, entitled, "An Act to Establish in this State Boards of Health and a Bureau of Vital Statistics, and to define their Respective Powers and Duties," approved March 31, 1887, and of other acts, doth hereby ordain as follows:

ARTICLE 1. DEFINITION OF TERMS.

SECTION 1. The term "Board of Health" or "Board" as used in this ordinance shall be construed to mean the Board of Health of the Town of Montclair or its official representative, except where otherwise specified, when the Board is not in session.

SEC. 2. The term "Person" as used in this ordinance shall be construed to mean any person or persons, corporation or association of persons.

SEC. 3. The term "Food" as used in this ordinance shall include every article used for food or drink by man, and every ingredient in such article, and all confectionery.

ARTICLE 2. NUISANCES.

SEC. 1. Whatever is dangerous to human health, whatever renders the ground, the water, the air, or food a hazard or an injury to human health, and the follow-

ing specific acts, conditions and things are, each and all of them, hereby declared to constitute nuisances:

(a) The deposit or accumulation of any foul, decaying, or putrescent substance or other offensive matter in or upon any lot, street, or highway or in or upon any public or private place; the storage of such foul or decaying or putrescent matter in liquid or solid form in any vault, cesspool or other receptacle; the overflow of any foul liquids or the escape of any gases to such an extent that the same or any one of them shall become or be likely to become hazardous to health or that the same shall, by reason of offensive odors, become a source of discomfort to persons living or passing in the vicinity thereof.

(b) A polluted well, spring, or stream or the pollution of any body of water used for drinking purposes.

(c) The maintenance of any privy vault or cesspool.

(d) Keeping any building or room in such a state of uncleanliness or the crowding of persons in any building or room in such a manner as to endanger the health of the persons dwelling therein; or so that there shall be less than 400 cu. ft. of air to each adult and 150 cu. ft. of air to each child under twelve years of age occupying such building or room.

(e) Allowing cellars to be used as sleeping rooms.

(f) A building or portion of a building occupied as a dwelling which is not lighted and ventilated by means of at least one window in each room, said window opening to the outer air; which is not provided with a plentiful supply of pure water; which is not provided with at least one water closet (or privy when no sewer is available) for every two families; which is not provided with one sink for each family, said sink to be connected to a properly constructed cesspool if no sewer is available; and which is not provided with plumbing that is kept at all times in a sanitary condition.

(g) Renting or occupying any building or portion of a building, dwellings excepted, for any purpose whatsoever except it be provided with at least one water closet for every 15 persons, or fraction thereof, employed therein.

(h) The accumulation of manure unless it be in a properly constructed pit.

(i) The accumulation of water in which mosquito larvae breed.

SEC. 2. Any person maintaining or aiding in the creation or maintenance of any nuisance shall, upon conviction thereof, forfeit and pay a penalty of $10 for the first offense and $25 for each subsequent offense, and each day during which a nuisance is allowed to exist shall constitute a separate and distinct offense.

ARTICLE 3. PRIVY VAULTS, CESSPOOLS AND MANURE PITS.

SEC. 1. No privy vault, cesspool nor manure pit shall hereafter be constructed in the Town of Montclair without a permit therefor from this Board. This shall not prohibit the construction of temporary privy vaults during the erection of new buildings, but in all such cases the contractor shall cause the contents of such vaults to

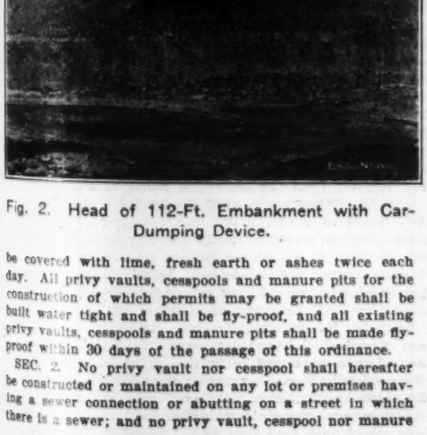


Fig. 2. Head of 112-Ft. Embankment with Car-Dumping Device.

be covered with lime, fresh earth or ashes twice each day. All privy vaults, cesspools and manure pits for the construction of which permits may be granted shall be built water tight and shall be fly-proof, and all existing privy vaults, cesspools and manure pits shall be made fly-proof within 30 days of the passage of this ordinance.

SEC. 2. No privy vault nor cesspool shall hereafter be constructed or maintained on any lot or premises having a sewer connection or abutting on a street in which there is a sewer; and no privy vault, cesspool nor manure pit shall hereafter be constructed within 50 ft. of any spring, well or stream, within 5 ft. of any party line or fence, within 15 ft. of the line of any street or within 25 ft. of the door or window of any house; nor shall any cover be put upon or over the same until the said privy vault, cesspool or manure pit has been inspected and approved by the Board of Health.

SEC. 3. No rain water leader, waste pipe nor soil pipe shall discharge into or be connected with any

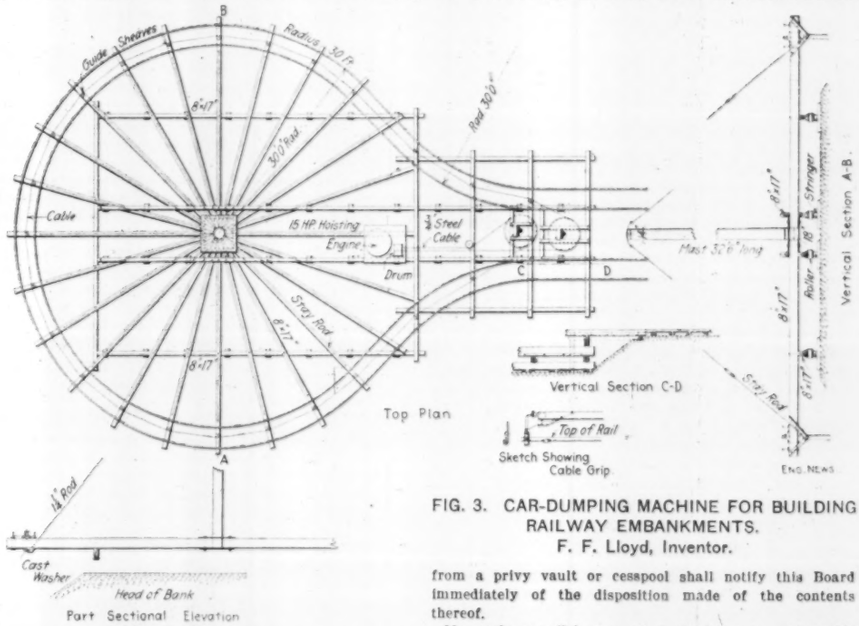


FIG. 3. CAR-DUMPING MACHINE FOR BUILDING RAILWAY EMBANKMENTS.
F. F. Lloyd, Inventor.

privy vault, nor shall a privy vault, cesspool or manure pit be directly or indirectly connected with any sewer. No drainage from any stable or other building shall discharge into a manure pit. Every manure pit shall be kept dry.

SEC. 4. Any person violating any of the provisions of this article shall, upon conviction thereof, forfeit and pay a penalty of $10, and each day during which a violation of this article is allowed to exist shall constitute a separate and distinct offense.

ARTICLE 4. STORAGE, REMOVAL AND DISPOSAL OF REFUSE MATTER.

SEC. 1. No privy vault nor cesspool in the Town of Montclair shall hereafter be cleaned, nor shall any material from the same, nor any garbage, ashes, swill, refuse, dead animals or other matter which is or which may become offensive or dangerous to health be conveyed through the streets of Montclair, by any person who has not first obtained a license from this Board permitting him to perform such services or acts in accordance with the provisions of this article and of such other ordinances, rules and regulations as the Board may from time to time adopt.

SEC. 2. All persons required by the preceding section to obtain a license shall make application for the same to the Board of Health, in writing, stating the nature of the business they intend to conduct, or the acts to be performed, the number and kind of wagons or other vehicles to be used in such business, and the disposition to be made of the material they may remove, collect or convey, and also stating such other information as the Board of Health may from time to time require. In case an application is granted, the Board of Health, at a regular meeting, shall issue a license for one year to the applicant upon receipt of the proper license fee or fees established by this article.

SEC. 3. The license fee to be paid under this article shall be as follows:

For each permit to empty cesspools, the sum of $10 for the first wagon or other vehicle, and $5 for each additional wagon or vehicle.

For each permit to empty privy vaults, the sum of $10 for the first wagon or other vehicle, and the sum of $5 for each additional vehicle.

For each permit to remove dead animals, the sum of $2 without regard to the number of vehicles employed.

For each permit to collect and remove garbage, ashes, swill and other material included in Section 1, and not previously included in this section, the sum of $3 for the first wagon or other vehicle employed, and the sum of $1 for each additional wagon or vehicle.

Such license may be revoked at any time by the Board whenever, in its judgment, the licensee has violated any provision of this article or any rule, regulation or order made by this Board.

SEC. 4. All vehicles or receptacles used under any permit from the Board of Health shall be such as may be approved by the said Board, shall be kept clean and inoffensive, and shall be covered with tightly fitting wooden, metal or canvas covers, securely fastened, which covers shall be kept closed at all times, except when opened for the admission or discharge of proper matter.

SEC. 5. None of the material collected, conveyed or handled under this article shall be disposed of within the Town of Montclair in any manner not approved by the Board of Health; and every person removing night soil from a privy vault or cesspool shall notify this Board immediately of the disposition made of the contents thereof.

No garbage, offal, nor other decaying or putrescible matter, either by itself or in connection with ashes or other harmless matter, shall be used for the purpose of filling in any lot or other space.

SEC. 6. All garbage and offal which shall accumulate anywhere in the Town of Montclair, or which is stored, kept or retained therein, shall be kept in water-tight iron or steel receptacles provided with tightly fitting covers, all properly treated to prevent corrosion.

SEC. 7. The contents of said receptacles shall be emptied only into vehicles licensed by this Board. Said receptacles shall be kept clean, and no rainwater nor any other fluid shall be allowed to enter therein, except for purposes of cleaning.

SEC. 8. No such vehicle shall stand in the streets or other public places at any time except when being loaded.

Every wagon and vehicle licensed under this article shall have its license number conspicuously painted upon each side thereof, in figures at least 4 ins. high.

SEC. 9. Any person violating any of the provisions of this article shall, upon conviction thereof, forfeit and pay a penalty of $10 for each offense.

ARTICLE 5. SPITTING IN PUBLIC PLACES.

SEC. 1. Spitting upon the floor, platform or any other part of a public conveyance, upon the floor, steps or stairs of any public building, school, hall, church, store,

Fig. 4. Arrangement of Tracks at Car-Dumping Machine.

shop or railway station, upon the sidewalk of any public or private street, upon the pathway of any park, or in any other public place, is hereby declared to be a nuisance, and any person or persons creating such a nuisance shall, upon conviction thereof, forfeit and pay a penalty of $2 for each offense.

ARTICLE 6. SWINE AND CATTLE.

SEC. 1. Any person desiring to keep swine or cows within the Town of Montclair shall, before keeping the same, apply to the Board of Health in writing, stating the location of the enclosure in which it is proposed to keep the said swine or cows and the approximate number which is to be kept in said enclosure; and no person shall keep the said swine or cows unless said petition is favorably acted upon by the Board of Health at a regular meeting, and a permit in writing is granted by said Board.

SEC. 2. Any person violating any of the provisions of this article, shall, upon conviction thereof, forfeit and pay a penalty of $10, and each day during which a violation of this article is allowed to exist shall constitute a separate and distinct offense.

ARTICLE 7. FOOD.

SEC. 1. The sale or exposure for sale of any article of food that is decayed or putrefied, or that has become chemically or physically changed so that it is unwholesome or unfit for food, or that has been exposed to the infection of any communicable disease, is hereby prohibited, and all such food shall be disposed of in a manner approved by this Board.

SEC. 2. All fruit, vegetables and other food stored or exposed for sale upon any sidewalk or outside of any building in the Town of Montclair shall be placed upon stands, tables or other structures having a height of at least 20 ins. above the sidewalk or ground. No food which ordinarily is consumed without further cooking (fruit and vegetables excepted) shall be exposed for sale outside any building or within any store, or delivered except in closed containers.

SEC. 3. No sleeping room nor any room of a dwelling, apartment or tenement shall be directly connected with a room which is used as a restaurant or public dining room or with the room in which the food for consumption in said dining room is to be prepared or cooked.

SEC. 4. No store in which food is sold shall be directly connected with any sleeping room or with any room of a dwelling, apartment or tenement.

SEC. 5. All bakeries or bake shops in the Town of Montclair shall be open at any time to inspection by this Board. Said bakeries or bake shops shall be kept in a thoroughly sanitary condition, shall be used for no other purpose and shall not be connected with any sleeping room nor with any room of a dwelling, apartment or tenement.

SEC. 6. All persons engaged in the sale of ice cream in the Town of Montclair shall file with this Board before the first day of June of each year a true statement of the place where the milk and cream to be used is produced, of the place of manufacture and from whom said ice cream is purchased. All premises where ice cream is manufactured for sale in Montclair shall be kept in a thoroughly sanitary condition and shall be open to this Board for inspection at any time. No refrozen ice cream, nor any ice cream one or all of the various ingredients of which could not be sold separately under this ordinance, shall be sold or offered for sale in the Town of Montclair.

SEC. 7. All persons hereafter engaged in the sale of ice in the Town of Montclair shall file with this Board before the first day of June of each year a complete list of places from which said supply is originally obtained, and said Board shall be notified immediately of any change in the source of the supply. No supply shall be obtained from a source which is contaminated or which is so situated that it may become contaminated.

SEC. 8. No milk shall be sold from any store unless said store has adequate facilities for keeping said milk at a temperature below 50° F., and no milk shall be stored or sold at a temperature higher than 50° F. All milk shall be kept and delivered in the original bottles.

SEC. 9. All refrigerators or ice boxes maintained in any butcher shop or other mercantile shop in the Town of Montclair shall be open to inspection by this Board at any time when business is being carried on in said shop. No person shall allow any animal or vegetable matter which is foul or which is in a state of decay to remain within said refrigerator or ice box, nor shall the said refrigerator or ice box be allowed to become foul or malodorous.

SEC. 10. All glasses or other drinking utensils used at soda fountains, inn-taverns, or at other refreshment stands, shall be washed and rinsed in running water before each separate use thereof.

SEC. 11. Any person violating any of the provisions of this article shall, upon conviction thereof, forfeit and pay a penalty of $10 for the first offense and $25 for each subsequent offense.

ARTICLE 8. MILK AND ITS PRODUCTION.

SEC. 1. No milk shall hereafter be produced, sold, exposed for sale or delivered within the Town of Montclair unless it is produced and handled in accordance with the requirements of this article.

SEC. 2. No person shall hereafter engage in the sale or exposure for sale of milk within the Town of Montclair without first having filed with the Board of Health a true and complete statement of the locality from which all the milk they handle is produced, a complete list of the persons from whom the said milk is purchased, and a complete list of the localities from which ice for cooling purposes is obtained; and if at any time the place at which said milk is produced or the persons from whom the said milk is purchased or the locality from which said ice is obtained be changed, the said Board shall be notified immediately. On or before the fifteenth day of June and of December of each year, and at any other time within three days of the receipt of a request therefor, any person engaged in the sale of milk in Montclair shall furnish said Board with a complete list of all persons to whom milk is regularly sold.

SEC. 3. All premises whereon milk is produced or handled for sale or distribution in the Town of Montclair shall be open to this Board for inspection at any time, and owners of cows from which said milk is produced shall permit a veterinarian in the employ of this Board to examine said cows at any time.

SEC. 4. STABLES. Cows shall be stabled under light, dry and well ventilated conditions, and the stables shall conform in all respects to the requirements hereinafter set forth, viz.:

(a) Any portion of a barn used as a cow stable shall be tightly ceiled overhead, shall be entirely partitioned off from the rest of the barn and shall not be used for the storage of farm utensils, nor for any other purpose.

(b) The walls and ceilings of said stables, not otherwise treated in a manner approved by this Board, shall be whitewashed at least every six months.

(c) Stables shall have at least 2 sq. ft. of unobstructed window glass per 500 cu. ft. of air space, the windows to be arranged so as to light all portions of the stable effectively.

(d) Each cow shall have at least 3 ft. in width of floor space when fastened in stanchions, and in all cases where no adequate artificial means of ventilation is provided, each animal shall have air space of at least 600 cu. ft.

(e) All stables shall be provided with a tight, dry floor and the manure drops or urine gutters shall be watertight and shall be thoroughly cleaned at least twice each day.

(f) No manure, garbage, nor other putrescible matter shall be allowed within 100 ft. of any cow stable, milk house, or cooling room; and the drainage from said buildings shall be such that no liquid wastes can collect within this distance.

SEC. 5. COWS AND FEED. (a) No milk shall be sold or offered for sale or distributed in the Town of Montclair except from cows in good health nor unless the cows from which it is obtained have, within one year, been examined by a veterinarian whose competency is vouched for by the State Veterinary Association of the State in which the herd is located, and a certificate signed by such veterinarian has been filed with the Board of Health stating the number of cows in each herd that are free from disease. This examination *shall include the tuberculin test* and charts showing the reaction of each individual cow shall be filed with this Board. All cows which react shall be removed from the premises at once if the sale of milk is to continue, and no cows shall be added to a herd until certificates of satisfactory tuberculin tests of said cows have been filed with this Board.

(b) Cows shall at all times be kept in a clean condition and the udders shall be washed or wiped with a clean, damp cloth immediately before milking.

(c) No milk shall be obtained from any cow which has calved within 10 days or from any cow within 30 days before the normal time of calving.

(d) All milk shall be obtained from cows fed and watered under the following conditions: All food given to such cows shall be sweet and wholesome. The use of either distillery slops or fermented brewery grains is prohibited, and their presence on any dairy premises will be considered sufficient cause for the exclusion of the milk from such dairies from sale or delivery in said town. Water supplied to cows shall be pure and free from all contamination from stable or household wastes, and no spring or shallow well in or adjoining any stable yard shall be used for watering said cows.

SEC. 6. EMPLOYEES AND UTENSILS. (a). All milkers and all other attendants handling milk in any dairy shall be personally clean. When entering upon their duties connected with the dairy their hands and outer garments must be clean.

(b) Utensils used for the collection and transportation of milk shall, before being used, be thoroughly washed with pure water and soda or soap, or by some other approved means, and then *sterilized by steam.*

(c) As soon as milk is drawn from a cow, and before straining, it must be removed from the stable to a separate room where it shall be strained immediately. It shall then, within 45 minutes of the time of milking, and in a building separate from the said stable, be cooled to 50° F., or below, by some method approved by this Board. The above-mentioned cooling room shall be properly ventilated and lighted, shall be used for no other purpose than that indicated above, shall at all times be kept in a clean condition, and shall not be connected with any stable, barn or dwelling.

(d) All milk shall be delivered in bottles, but no milk in partially filled bottles shall be sold or offered for sale. No tickets shall be used in connection with the sale or delivery of milk. No bottles shall be filled, capped or recapped outside the dairy building regularly used for this purpose and said bottling room shall at all times be kept in a clean and sanitary condition. Milk bottles shall be used for no other purpose than as receptacles for milk.

(e) If at any time any person or persons having any connection with a dairy, or with the handling of milk, or any resident member of the family of any person so connected, shall be stricken with cholera, small pox, diphtheria, membranous croup, typhus, typhoid or scarlet fever, measles, tuberculosis, syphilis or any other communicable disease that may hereafter be declared by this Board to be dangerous to the public health, notice shall be given to said Board immediately by the owner or owners of such dairies, and said Board may order the sale of such milk discontinued for such time as it deems necessary. No milk produced from the dairy of any person failing to give notice shall hereafter be sold or exposed for sale or delivered in the Town of Montclair until special permission therefor has been granted by said Board.

SEC. 7. MILK. (a) Samples of milk shall be furnished this Board by any producer or dealer at any time upon proper payment therefor.

(b) Milk supplies found to contain over 100,000 bacteria per c.c. on two or more different days will be excluded from Montclair until satisfactory evidence is shown that the milk may be reasonably expected to contain less than this number of bacteria.

(c) No pasteurized milk shall be sold in the Town of Montclair unless it is conspicuously labelled "PASTEURIZED." Said label shall also state the degree (temperature and length of exposure at that temperature) and date of pasteurization.

(d) No substance or compound shall be added to any milk which is to be exposed or offered for sale and no substance shall be subtracted therefrom.

(e) No milk shall be sold in Montclair which is obtained from a dealer who handles in part a supply not approved by this Board; and no person shall deliver or offer for sale in the Town of Montclair any milk unless the entire supply which he handles complies with the requirements hereinbefore set forth, unless satisfactory evidence is given this Board that the two supplies are kept separate.

(f) No milk shall be delivered, stored, or transported at a temperature exceeding 50° F.

(g) No ice which is obtained from a source which is contaminated or which is so situated that it may become contaminated, shall be used for cooling milk.

SEC. 8. CREAM. No cream shall be sold, exposed for sale or delivered within the Town of Montclair unless it be produced and handled in accordance with the requirements hereinbefore set forth for the production and handling of milk.

SEC. 9. Any person violating any of the provisions of this article shall, upon conviction thereof, forfeit and pay a penalty of $25 for each offense.

ARTICLE 9. THE REGISTRAR AND THE REGISTRATION OF VITAL STATISTICS.

SEC. 1. There shall be appointed annually, by the Board of Health, a suitable person to be Registrar of Vital Statistics in and for the Town of Montclair, in the County of Essex, who shall serve until the first day of January next succeeding his appointment, or until his seccessor is appointed and qualified.

SEC. 2. In addition to the duties prescribed to be performed by such officer by the Laws of the State, the Registrar of Vital Statistics shall perform such other duties as may from time to time be required by the Board of Health. He shall, in addition to transmitting to the State Bureau of Vital Statistics all certificates of marriages, births and deaths received by him, report the same to the local Board of Health at least once in each month.

SEC. 3. The returns of all marriages, births and deaths required by law, or by any ordinance of the Board of Health, to be made by physicians, midwives, nurses, clergymen, magistrates, undertakers and other persons professionally officiating at such marriage, birth or death, shall be made to the Registrar of Vital Statistics, and for each failure to make return or report of such marriages, births or deaths within the time specified by law, said person shall, upon conviction thereof, forfeit and pay a penalty of $20.

ARTICLE 10. COMMUNICABLE DISEASES.

SEC. 1. Every physician shall report in writing to this Board the name of every patient he or she may have in the Town of Montclair with cholera, smallpox, diphtheria, typhus, typhoid or scarlet fever, measles, tuberculosis in any form, varicella, mumps, whooping cough, epidemic dysentery, trachoma, malaria, epidemic cerebro-spinal meningitis, or any other communicable disease that may be hereafter declared by this Board to be dangerous to the public health, together with the precise locality where such patient may be found, immediately after such physician shall ascertain the nature of such disease, and shall be entitled to receive 10 cts. therefor from the disbursing officer of the town.

SEC. 2. Whenever it shall be deemed necessary by this Board to establish the true character of any disease which is suspected to be communicable, a medical examination of the person or persons affected by such disease may be ordered by said Board. Any person or persons interfering with or refusing to permit such examination shall be guilty of violating this article.

SEC. 3. No principal, teacher, nor superintendent of any school shall knowingly permit any child sick with any disease mentioned in Section 1, or with any other communicable disease, or any child residing in any house in which scarlet fever, diphtheria, smallpox, measles or epidemic cerebro-spinal meningitis shall exist, to attend any school until such time as the Board of Health certi-

fies to such teacher, principal or superintendent that the said child may attend school without danger of communicating the disease to others.

SEC. 4. No person from any dwelling wherein a disease dangerous to the public health exists shall take any book or magazine to or from any circulating library. The Board will inform the librarian of all cases of said diseases, and until a written permit is given he shall allow neither books nor magazines to be taken to or returned from a dwelling where such cases exist.

No person shall remove milk bottles from a building wherein a disease dangerous to the public health exists, or has existed, until he has first obtained permission in writing from the Board of Health.

SEC. 5. Any person in the Town of Montclair having communicable disease shall be isolated as the Board of Health may direct, and all buildings, clothing, property, premises and vehicles which may be infected by emanations from such persons shall be disinfected as the Board of Health may direct. No premises will be disinfected after diphtheria until at least two negative cultures, taken on successive days, have been obtained from the throat of the patient, or from the nose if a case of nasal diphtheria.

SEC. 6. No person shall knowingly bring or cause to be brought into the Town of Montclair any person infected with any communicable disease, except upon a permit granted by the Board of Health; and no person shall knowingly bring or cause to be brought into said town any article liable to propagate a communicable disease.

SEC. 7. Whenever there shall occur in the Town of Montclair any case of cholera, smallpox, diphtheria, membranous croup, typhus or scarlet fever the Board of Health shall place upon the house or houses in which said case or cases are confined a placard naming the disease, said placard to remain until the said premises are disinfected by the said Board; and any person or persons removing said placard without the authority of said Board, shall, upon conviction thereof, forfeit and pay a penalty of $50.

SEC. 8. Whenever a placard shall be placed, as provided in Section 7, no person nor persons, except the medical attendant and nurses, shall either enter therein or depart therefrom without the permission of the Board of Health.

SEC. 9. In case a coach, hack, cab, carriage or other vehicle shall convey a patient suffering from a communicable disease, said vehicle shall be disinfected under the direction of the Board of Health before being used again.

SEC. 10. Whenever a person with tuberculosis moves out of a house or an apartment, the attending physician, if there be one, or the active head of the family, shall so notify this Board within 24 hrs., and both of the above-mentioned persons shall be held equally responsible for a violation of this section.

SEC. 11. Every veterinarian or other person who is called to examine or professionally attend any animal within the Town of Montclair, having the glanders or farcy, rabies, tuberculosis or any other communicable disease, shall, within 24 hrs. thereafter, report in writing to the Board of Health the following facts:

(1) A statement of the location of such diseased animal.

(2) The name and address of the owner thereof.

(3) The type and character of the disease.

SEC. 12. Every animal which is mad or which has hydrophobia, or which shows symptoms thereof, shall be at once killed or else securely confined until the diagnosis is accurately made. Every animal that has been exposed to such disease shall be at once confined in some secure place for such length of time as to show that such exposure has not given such animal said disease, and the body of any animal that has died of such disease, or which being suspected to have such disease has been killed, shall be disposed of as may be directed by the Board of Health.

SEC. 13. Any person violating any of the provisions of this article, shall, upon conviction thereof, forfeit and pay a penalty of $50.

ARTICLE 11. BURIAL OF THE DEAD.

SEC. 1. No body of an adult person shall be buried in the Town of Montclair so that the box or coffin containing it shall be nearer than 4 ft. to the surface of the ground, or in the case of any person deceased under the age of 14 years, less than 3½ ft., and no disinterment shall take place between the first day of May and the first day of the following November of any year, nor shall any disinterment take place at any time without a permit from the Board of Health.

SEC. 2. There shall not be a church or other public funeral of any person who has died of smallpox, diphtheria, membranous croup, scarlet fever, measles, yellow fever, typhus fever, leprosy or Asiatic cholera; but the funeral of such person shall be private, and the burial shall take place within 24 hrs. after the death of said person. It shall not be lawful to permit at the funeral of any person who has died of any of the above-named diseases, or at any services connected therewith, any person whose attendance is not necessary.

SEC. 3. Every undertaker having notice of the death of any person within the Town of Montclair from smallpox, varioloid, diphtheria, membranous croup, scarlet fever, typhus fever, Asiatic cholera, leprosy, measles or any other communicable disease dangerous to the general health of the community, or of the bringing of the dead body of any person who has died of any such disease into said town, shall give immediate notice thereof to the Board of Health.

SEC. 4. No public coach, hack, cab or carriage, nor any upholstered vehicle used for the conveyance of passengers, shall be used to convey the body of a person who has died from any communicable disease.

SEC. 5. Any person, corporation or association of persons violating any of the provisions of this article, shall, upon conviction thereof, forfeit and pay a penalty of $50 for each offense.

ARTICLE 12. BARBER SHOPS.

SEC. 1. Every barber shop within the Town of Montclair shall be open to this Board for inspection at any time, and the following rules shall be observed therein:

(a) All barber shops, together with all furniture, shall be kept in a clean and sanitary condition.

(b) Mugs, shaving brushes, razors, scissors, clipping machines, pincers, needles and other instruments shall be sterilized, either by immersion in boiling water or in alcohol of at least 60% strength, after each separate use. Combs and brushes shall be thoroughly cleaned with soap and water after each separate use.

(c) Clean towels shall be used for each person.

(d) Alum, or other material used to stop the flow of blood, shall be applied only on a clean towel or other clean cloth.

The use of powder puffs and sponges is prohibited, except that a sponge owned by a customer may be used on him.

(e) Every barber shall thoroughly cleanse his hands immediately before serving each customer.

(f) Every barber shop shall be well ventilated and provided with running hot and cold water.

(g) No barber shop shall be used as a sleeping room.

(h) A copy of this article shall be kept posted in plain view in every barber shop.

SEC. 2. Any person violating any of the provisions of this article shall, upon conviction thereof, forfeit and pay a penalty of $10 for each offense.

ARTICLE 13. TENEMENT HOUSES.

SEC. 1. Chapter 61 of the State Laws of New Jersey, Session of 1904, entitled, "An Act to Improve the Condition of Tenement Houses in This State and to Establish a State Board of Tenement House Supervision," together with amendments thereto, is hereby incorporated into and made a part of this Ordinance in so far as it relates to light, air space, sleeping quarters, dirt and filth, storage of refuse, sewer connections, plumbing, cesspools and privies; and any person violating any of the above-mentioned provisions of the said Act shall, upon conviction thereof, forfeit and pay a penalty of $50 for each day during which a violation of said Act is willfully allowed to exist.

ARTICLE 14. STREET CARS.

SEC. 1. All street cars operated in the Town of Montclair shall be kept in a thoroughly clean and sanitary condition and a sufficient number of ventilators shall be open at all times to provide a plentiful supply of pure air. At the end of each trip trolley cars shall be ventilated as follows: The doors at each end of the car shall be opened wide and shall remain open for at least two minutes.

SEC. 2. Conductors shall be responsible for the condition of their cars, and any conductor or other person violating or offending against any of the provisions of this article shall, upon conviction thereof, forfeit and pay a penalty of $10 for each offense.

ARTICLE 15. SEWER CONNECTIONS.

SEC. 1. All owners of property along the line of any sewers constructed for the purpose of carrying off sewage matter in any of the streets of Montclair shall connect their houses and other buildings with the sewer in the street adjoining said property upon notice from the Board of Health to make such connection. Said notice shall be served by delivering the same to the owner of said property, or by leaving the same at the residence of the owner with a member of the family above the age of 14 years, and explaining the contents thereof; or, in case of a non-resident owner, by serving the same upon the resident agents, if any, and by mailing the same by registered letter to the owner's last-known post-office address.

SEC. 2. Any owner of property who fails to make such connection within thirty days after notification from this Board, shall, upon conviction thereof, forfeit and pay a fine of $25, and an additional fine of $10 for each and every day after the said 30 days in which the provisions of this article and of such notice shall not be complied with.

ARTICLE 16. THE CONSTRUCTION OF PLUMBING.

SEC. 1. All plumbing and house drainage hereafter installed in the Town of Montclair shall be executed in conformity to the rules, regulations and specifications of this article.

SEC. 2. DEFINITION OF TERMS. The following terms when used in this article shall be construed as follows:

"House" to mean any building.

"House Sewer" to mean that portion of the sewerage system of any building which extends from a point five feet outside the wall of the building to its connection with either a public sewer or a cesspool.

"House Drain" to mean the entire length of horizontal pipe from the house sewer to the soil pipe.

"Soil Pipe" to mean any line of pipe which is designed to convey the discharge from one or more water closets, with or without the wastes from other plumbing fixtures, to the house drain.

"Main Waste" to mean any line of pipe which receives the waste water from plumbing fixtures of any kind except water closets and slop hoppers and is extended upwards through the roof.

"Branch Waste" to mean the length of waste pipe conducting waste water from fixtures except water closets and slop hoppers to the main waste or soil pipe.

"Vertical" to mean more than 45° from the horizontal.

SEC. 3. MATERIALS, QUALITY AND WEIGHT.—All material used in the installation of plumbing in the Town of Montclair shall conform to the following specifications:

(a) All tile pipe and fittings shall be of the hub or spigot pattern, cylindrical, vitrified, of uniform caliber and smooth bore and free from fire cracks, flaws or other defects.

(b) All cast-iron pipe shall be of the grade known as extra heavy, of uniform thickness, and free from flaws, cracks, or other defects. Each length must be truly cylindrical, straight, smooth and sound, with deep sockets. Each length of pipe, trap or fitting shall have the size thereof, weight per foot and maker's name clearly cast or stamped upon the exterior surface thereof. The weight of such pipe per lineal foot must be as follows:

2-in. pipe to weigh 5½ lbs.	5-in. pipe to weigh 17 lbs.
3-in. pipe to weigh 9½ lbs.	6-in. pipe to weigh 20 lbs.
4-in. pipe to weigh 13 lbs.	

All cast-iron traps and fittings shall correspond in quality, weight and finish with the above specifications.

(c) All wrought-iron or steel pipe shall be lap-welded, equal in weight and quality to standard lap-welded pipe, and properly tested at the pipe mills. All wrought-iron or steel pipe shall be galvanized or otherwise protected from corrosion by some method approved by this Board. The weight of wrought-iron or steel pipe shall not be less per lineal foot than the following:

1½-in. pipe to weigh 2½ lbs.	4-in. pipe to weigh 10½ lbs.
2 -in. pipe to weigh 3½ lbs.	5-in. pipe to weigh 14½ lbs.
3 -in. pipe to weigh 7½ lbs.	

All wrought-iron or steel fittings shall be galvanized or otherwise protected as aforesaid, and such fittings below the water line, or highest fixture, shall be those known in the trade as galvanized drainage fittings.

(d) Lead pipe shall be of the best quality drawn pipe of the grade known in the trade as "D," and shall weigh, per lineal foot, as follows:

1½-in. pipe to weigh 3½ lbs.	3-in. pipe to weigh 6 lbs.
2 -in. pipe to weigh 4 lbs.	4-in. pipe to weigh 8 lbs.

Lead traps shall be of the same weight as specified for lead pipe.

(e) Brass ferrules shall be of the best quality, extra heavy cast or drawn brass, bell-shaped, not less than 4 ins. long, and shall have the following weight:

2½-in. diam. to weigh 1 lb. 4½-in. diam. to weigh 2 lbs.
3½-in. diam. to weigh 1¾ lbs.

(f) All cleanouts in a plumbing system must be closed with extra heavy brass screw caps, and the body of the cleanout ferrule shall be at least equal in length to the calking ferrule for the same size of pipe. Said cleanouts shall be the full size of the pipe.

SEC. 4. SIZES OF PIPES AND TRAPS. In the installation of any plumbing in the Town of Montclair, the pipes, traps and fittings used shall be of the following sizes:

(a) House sewers shall not be less than 5 nor more than 6 ins. in internal diameter.

(b) House drains shall be 4 ins. in internal diameter unless they serve more than eight water closets, in which case the internal diameter shall be at least 5 ins.

(c) Soil pipe shall be 4 ins. in internal diameter unless it serves more than ten water closets, in which case the internal diameter shall be at least 5 ins.

(d) Main wastes shall be 2 ins. in internal diameter unless they serve more than six fixtures, in which case the internal diameter shall be at least 3 ins.

(e) Branch wastes shall be 2 ins. in internal diameter for all fixtures except basins. Branch wastes for basins shall be 1½ ins. in diameter.

(f) The size of traps shall be the same as the branch waste pipe to which they are connected.

SEC. 5. JOINTS AND CONNECTIONS. All joints and connections in any plumbing in the Town of Montclair shall be made according to the following specifications:

(a) Joints between tile pipes and fittings shall be of Portland cement.

(b) Joints between cast-iron pipes and fittings shall be calked joints made with a gasket of hemp or oakum and molten lead, the amount of lead to each joint to be

at least twelve ounces for every inch of diameter of the pipe. All such joints shall be calked and made water tight.

(c) Joints between iron and tile pipe shall be made with Portland cement and in no case shall the iron pipe be more than one size smaller than the vitrified pipe.

(d) Joints between wrought-iron pipes and fittings shall be screw joints, and all burrs shall be carefully reamed out.

(e) Joints in lead pipe shall be wiped.

(f) Joints between lead and wrought-iron pipe or fittings shall be made with brass soldering nipples.

(g) Joints between lead and brass pipe shall be wiped joints.

(h) Joints between lead and cast-iron pipe or fittings shall be made with brass ferrules, the ferrules to be calked into the iron fittings and joined to the lead pipe by wiped joints.

(i) No connection shall be made by drilling or tapping a pipe.

(j) Earthen or iron water closets having traps above the floor and using lead connections must have a cast brass flange not less than ⅛-in. thick soldered to the lead bend and bolted to the closet. The joint shall be made permanently air tight.

SEC. 6. HOUSE SEWERS, MATERIAL AND ARRANGEMENT. House sewers shall be of tile pipe and laid with the following restrictions, or of extra heavy cast-iron pipe: Tile pipe shall not begin nearer than 5 ft. to the opening in the exterior wall in the building, nor shall it be laid less than 3 ft. from the surface of the ground; and no line shall be laid within 3 ft. of the wall of any building or of any party line, nor within 2 ft. of any parallel line of water or gas pipe. House sewers in soft, springy or "made" ground shall be of extra heavy cast iron. All house sewers shall have a fall of at least ¼-in. to 1 ft. and each length shall be given a solid bearing and grooves shall be cut in the bottom of the trench to receive the hubs. Said house sewers shall be inspected and approved by the Board of Health before being covered over with earth.

The plumbing of every building shall be separately and independently connected with the public sewer, when such is accessible, and if no sewer is accessible, with a proper cesspool; except that in the case of a building in the rear of a lot, in front of which there is another building, or in the case of a building which does not have access to a sewer over its own premises, the plumbing may be connected to the house sewer which serves another building.

SEC. 7. HOUSE DRAIN, MATERIAL AND ARRANGEMENT. The house drain shall be of extra heavy cast-iron and shall be supplied with at least two 4-in. "Y" cleanouts: The first at or near the point where the house drain leaves the foundation wall and on the inner side thereof; the second at the end of the house drain near its junction with the soil pipe. There shall also be a suitable cleanout at the end of each branch of the house drain over 10 ft. long. In case the house drain is below ground, it shall be laid in trenches to a uniform grade, and removable covers shall be placed over all cleanouts. Said cleanouts shall be surrounded by a brick, stone or cement pit of at least 2 ft. in diameter, and sufficiently deep to fall at least 2 ins. below the cleanout screw. All house drains shall have a fall of at least ¼-in. to 1 ft., and when above ground they shall be properly secured to the wall or suspended from the floor beams by strong iron hooks or hangers. Changes in direction must be made by means of long sweep quarter bends, by Ys or by ⅛ bends. Ts, T-Ys and ½ Ys are prohibited. Intercepting or main house traps are prohibited in all new work.

SEC. 8. SOIL PIPE, MATERIAL AND ARRANGEMENT. All soil pipe shall be of extra heavy cast iron or of wrought iron, and shall conform in quality to Section 3, except as stated below. Soil pipe over 10 ft. in length shall be carried, undiminished in size, to a height of at least 2 ft. above the roof and highest opening in the building and 6 ft. away from any chimney. Whenever located below or at one side of and within 20 ft. of dormer windows said pipes shall be carried up to the higher roof within the walls and to a point at least 2 ft. above said windows. All soil pipe extensions carried through the roof of an addition to any building the roof of which is not as high as that of the main building shall be continued upwards to a point at least 2 ft. above all doors and windows in the main building or of any other building, whether on the same or on an adjoining lot, if within 20 ft. of said doors or windows.

Soil pipe shall be run as nearly vertical as possible, and in all cases shall have a fall of at least ¼-in. to 1 ft. No quarter bends, except long sweep bends, will be permitted and when the direction is necessarily changed, Ys, ⅛-bends or long sweep bends must be used. No Ts shall be used, and T-Ys may be used on vertical lines only. In case a soil pipe is more than 5 ft. and less than 10 ft. in length, a 2-in. galvanized or cast-iron vent shall be run from a point within 2 ft. of the lead bend, and said vent may be used as a main waste. Each line of soil pipe shall rest at its foot upon a concrete or other masonry pier or foundation to prevent settling, and each line shall be properly secured to the wall or to floor beams. No soil pipe shall be run up outside any new building. In case, however, a new system is introduced into an old building the soil pipe may be run up on the outside of the building, and when so placed must be painted. No pipe so placed shall be supplied with branch fittings. In case of repairs or additions to old work where standard pipe is already installed, branch soil pipes taken out of the main stack above the first floor may be of standard pipe. A 4-in. soil line may be intersected above the highest fixture by one other 4-in. soil line or by two 2-in. lines before passing through the roof. No trap shall be placed at the foot of a vertical line of soil pipe.

SEC. 9. MAIN WASTES, MATERIAL AND ARRANGEMENT. All main waste pipes shall be of wrought or cast-iron pipe or steel, conforming in quality to Section 3, except that when below ground they must be of extra heavy cast iron. All main wastes shall be run as nearly vertical as possible, in no case having a fall of less than ¼-in. to 1 ft., and they shall always be so placed as to be within 3½ ft. of any fixture which they may serve. No quarter bends, except long sweep bends or long drainage quarter bends, nor needless offsets will be permitted, and when the direction is necessarily changed, Ys, ⅛-bends or long sweep bends must be used. No T shall be used on either horizontal or vertical lines and T-Ys will be permitted in upright lines only. Each main waste line shall rest at its foot on a concrete or other masonry pier or foundation to prevent settling. No main waste pipe shall be run up outside of any building. All main waste pipes shall be carried undiminished in size to a height above and distance away from doors and windows or dwellings to conform to the requirements laid down for soil pipe extensions. Main wastes shall be provided with a cleanout at their foot if there is a horizontal run of 10 ft. or more before they enter the house drain. A 2-in. line may be interesected by only one other 2-in. line, and above the highest fixture.

SEC. 10. BRANCH WASTES, MATERIAL AND ARRANGEMENT. Branch waste pipes shall not exceed in length 3½ ft. and shall be of lead, galvanized iron, brass or nickel; when of brass or nickel they shall be of standard size and weight; when of lead they shall be exposed to view throughout their entire length. All branch wastes must have a fall of at least ¼-in. to 1 ft. and must connect the fixtures which they serve to a soil pipe or main waste in as direct a manner as possible. No vertical branch waste will be allowed.

SEC. 11. TRAPS, MATERIAL AND ARRANGEMENT. All traps shall be equal in quality to the branch wastes to which they are connected. Non-siphoning traps of a pattern approved by the Board of Health shall connect each branch waste with the fixture which it serves. Said trap shall have a water seal of at least 2 ins., which seal shall be as near the fixture as possible, and in no case shall it be over 20 ins. from the fixture outlet. Bell traps, pot, bottle, "D" or "S" traps will not be permitted nor shall there be any ventilating or back-airing of traps. All traps shall be ½ S traps, and may be directly connected with the main waste pipe without a branch waste. In no case shall an extra main waste pipe be run for the purpose of ventilating the trap when the fixture is within 3½ ft. of a main waste or soil pipe. No trap depending on an interior partition of metal for a seal shall be used.

SEC. 12. FIXTURES AND WATER SUPPLY. All fixtures shall be provided with proper traps and no fixture shall be set unless supplied with sufficient water to properly flush it; if for any reason the supply of water is discontinued, except for repairs or replacements, the fixtures shall be removed at once. All fixtures shall be of non-absorbent material. Privy sinks, pan and valve closets and all water closets having any mechanism in connection with the bowl forming a mechanical seal, and all closets the walls of which are not thoroughly washed at each flush, are hereby prohibited. Every water closet installed in a plumbing system shall be placed in an apartment separate from the remaining rooms of the house; the said apartment to be used for no other than toilet purposes. Such apartment shall in all cases have external ventilation and shall be lighted by means of a window containing at least 3 sq. ft. of window glass and opening directly to the outer air.

Every water closet must be supplied with water from a separate tank or reservoir of at least 5 gals. capacity, or by some other means approved by this Board, and shall have a flush pipe of not less than 1¼ ins. in diameter. All water closets shall be provided with flushing rims and said flushing pipes shall connect with said rim so that said closets may be flushed in a proper and efficient manner. No water closet shall be supplied directly from the water supply pipe. All receptacles used as water closets shall be either of earthenware or of cast iron white enameled on the inside of the bowl and enameled or painted on the outside. No hopper closet shall be placed within any building used as a dwelling; when placed in yards they shall be in pits at least 3½ ft. deep and thoroughly protected against freezing. No vent pipe shall be attached to any porcelain vent horn provided upon closets, nor shall a vent pipe be run from the lead bend beneath the closet. No fixtures shall be enclosed.

SEC. 13. GENERAL REGULATIONS. (a) Lead bends shall be used to connect all water closets having traps above the floor with the soil pipe or house drain. No branch waste, main waste, trap or vent pipe shall connect with the lead bend of a water closet.

(b) Whenever safes are placed under fixtures the safe wastes shall be run separately to the basement or cellar and empty over a water-supplied fixture, the end being closed by a brass flap valve, or other improved device. Urinal platforms shall not be provided with safe wastes.

(c) No waste pipe from a refrigerator or other receptacle where food is kept shall be connected with the house drain, soil or other waste pipe. Refrigerator wastes may be arranged so as to empty over a water supplied sink, and in such cases the mouth of the pipe shall have a hinged brass flap valve.

(d) Whenever pipes pass through floors, the openings in both floors and ceilings shall be tightly closed.

(e) No steam exhaust, blow-off or drip pipe shall connect with a sewer, house drain, rain water conductor, soil, waste or vent pipe.

(f) Rain water leaders shall not be used as soil, waste, or vent pipes, nor shall they drain into the sewer. No house drain shall be used to drain any cellar.

(g) No drain from a carriage wash shall be connected with any sewer, house sewer, house drain or soil pipe.

(h) Wastes from slop sinks shall conform in all respects to the specifications laid down for soil pipes, with the exception that the internal diameter shall be 3 ins. The trap may be of lead.

(i) All hotels, railway stations, waiting rooms, or public buildings now existing or hereafter erected shall be provided with suitable toilet conveniences for both sexes. All urinals shall be of non-absorbent material and shall be placed in a room provided with a window containing at least 3 sq. ft. of unobstructed glass, which window shall open directly to the outer air. Said urinals shall be connected with the plumbing system in a manner approved by this Board, and they shall be provided with an automatic flush or with individual stop-cocks.

(j) Whenever it appears to this Board that the plumbing system in any building is not in a proper sanitary condition, the owner shall change the same to conform with the plumbing regulations herein set forth within 15 days of notification from this Board.

SEC. 14. FILING OF PLANS. No master nor foreman plumber nor building contractor nor other person shall do plumbing work in the Town of Montclair until plans and specifications are filed in the Office of the Board of Health for inspection and approval, and a permit issued, except in the following cases:

(a) Repairs of leaks or breaks or removal of stoppages.

(b) Replacement of all old fixtures, except water closets and slop hoppers, which replacement does not require the replacement of traps or waste pipes serving the said old fixtures.

Plans and specifications herein provided shall consist of suitable drawings, specifications and descriptions of the plumbing work to be performed. The said drawings, specifications and descriptions shall be made upon blanks furnished for that purpose by the Board of Health and shall show clearly the location of every pipe and fixture and the ventilation of bath rooms and toilets.

SEC. 15. FEES. When plans and specifications for plumbing work are filed with the Board of Health a fee of $2 must be paid to defray the expenses of inspecting the drawings and specifications, filing the same and superintending the work as provided hereinafter in Section 16, except in the following cases:

(a) Where it is proposed to add to an old system of plumbing a single new sink, basin, laundry tray or set of trays, bath tub or urinal and no change in main waste pipes is made.

(b) Where it is proposed to alter or replace water closets or any other plumbing in which the change in branch waste pipes only is made.

SEC. 16. TESTS. Every new plumbing system and every old system altered or extended must be tested by the plumber in the presence of the Board of Health in accordance with the following rules:

(a) The Board of Health shall be notified by the plumber as soon as the work is ready for inspection. All work must be left uncovered and convenient for examination and no coating of paint, tar or other substance shall be applied to the pipes until said work has passed the water test described below.

(b) WATER TEST. The water test must be used in the presence of the Board of Health for testing all plumbing work known as "roughing," except in freezing weather, when some method to be designated by this Board shall be used. The said test shall include all house drain, soil and main waste pipes, and joints thereof, ferrule joints and all traps and branch wastes which are to be enclosed. The house drain must be extended outside the foundation walls before the test is made. All defective joints must be made tight, all defective pipes and fittings must be removed and the system must be arranged to conform in all respects to the specifications hereinbefore set forth within one week of the date of testing. This Board shall be notified as soon as such changes are made and a retest similar to the first shall

be made immediately, after the payment of an additional fee of $1 to defray the expense of the second test.

(c) FINAL TEST. When the work is completed the Board of Health shall be notified and a final test shall be made by the plumber, in the presence of the Board of Health, within one week of the completion of such work. Said test shall be made with smoke or in any other manner which the Board may prescribe, and shall be made for every piece of plumbing work for which a fee is required, except buildings not used for human habitation. If the work is found defective it shall be changed within one week to conform to the specifications hereinbefore set forth and a fee of $2 must be paid to defray the expense of the second test, which shall be made by the plumber in the presence of the Board of Health and in the same manner as the first final test and within one week of the date of the first final test. No building shall be occupied as a dwelling until a final plumbing certificate is issued by the said Board, and the plumber or person authorized to do said work shall be held responsible for the proper condition of the plumbing work until it is finally approved. No certificate will be granted unless the work is done in a thoroughly workmanlike manner.

SEC. 17. All plumbing work in process of construction at the present time shall be tested in accordance with the requirements of this article, and all new work not already approved shall be tested as aforesaid within 30 days.

SEC. 18. PENALTY. Any person who fails to comply with or who violates or who offends against any provision of this article or any section thereof, shall, upon conviction thereof, forfeit and pay a penalty of $10, and each day during which a violation of this ordinance is allowed to exist shall constitute a separate and distinct offense.

ARTICLE 17. GAS PIPING.

SEC. 1. Any master or foreman plumber or gas fitter or other person proposing to install pipes for conducting illuminating gas in any building in the Town of Montclair shall, before installing said pipes, file with the Board of Health plans and specifications for the same with suitable and necessary drawings of the work to be performed. Said specifications and descriptions shall be made on blanks furnished for that purpose by the Board of Health and shall show clearly the number of outlets to be provided and the size of pipe to be used to supply each outlet.

SEC. 2. All pipe used in buildings as above specified shall be of the best quality of wrought iron.

SEC. 3. All fittings used for making connections between pipes shall be of galvanized, malleable iron.

SEC. 4. The piping of houses must be arranged according to the following rules:

Size of piping, ins.	Greatest length allowed, ft.	Maximum number of burners.
⅜	26	3
½	36	6
¾	60	20
1	80	35
1¼	110	60
1½	150	100
2	200	200
2½	300	300
3	450	450

No pipe less than ⅜-in. in diameter shall be used, and all risers shall be at least ¾-in. in diameter. The bending of pipes will not be permitted, but changes in direction must be made by means of fittings. No pipe shall be laid so as to support any weight, or so that it is liable to have weight thrust upon it by the deflection of beams.

SEC. 5. All lines of piping throughout any building, except drops, must be laid with a descent back to the risers, with no depression to hold condensation. Drops with drip pipes, where needed, must be provided at meters and at such other points as the plan of piping may render necessary. No pipes shall be laid under tile or parquet floors, marble or other stone or metal platforms, or under hearthstones, unless the local conditions render such procedure imperative, in which case galvanized pipes shall be used.

SEC. 6. When the gas pipes in any building are in position, the Board of Health shall be notified and an air test, under a pressure of at least 4 lbs. per sq. in., as indicated by a mercury gage, shall be made by the plumber or gas fitter in the presence of said Board before said pipes are enclosed or concealed in any way. All joints, pipes and fittings must be made tight, and no application of gas fitter's cement or similar material shall be applied to any part of the piping system.

When the system of piping is entirely completed, and after it is enclosed within walls and before the supply is turned on from the gas main in the street, another test similar to the one already described shall be applied by the plumber or gas fitter in the presence of said Board.

In case either of the above-mentioned tests reveals that the work is defective, or not in accordance with the requirements of this article, the system shall be made to conform to said requirements within three days of the date of testing, and a fee of $1 must be paid to defray the expense of each and every retest before such retest will be made. The said retest shall be made in the same manner as the first and second tests.

SEC. 7. No meter shall be set by any gas company or by any person until said person or corporation shall have obtained a certificate from the Board of Health stating that the gas pipes have been installed in accordance with the specifications hereinbefore set forth.

SEC. 8. Any person who fails to comply with, or who violates or who offends against, any provision of this article, or any section thereof, shall, upon conviction thereof, forfeit and pay a penalty of $10, and each day during which a violation of this article is allowed to exist shall constitute a separate and distinct offense.

ARTICLE 18. RIGHT OF ENTRY.

SEC. 1. This Board shall have the right to enter in or upon any premises at any reasonable hour of the day to determine whether nuisances exist therein or thereon, or to determine whether the provisions of this ordinance are being followed or obeyed. Any person opposing such entry shall, upon conviction thereof, forfeit and pay a penalty of $50 for each offense.

ARTICLE 19. REPEALER.

SEC. 1. All ordinances and parts of ordinances heretofore adopted by this Board are hereby repealed, except those for the prosecution and punishment of persons who may have violated any of the provisions thereof.

Passed April 9, 1907.

M. N. BAKER, Pres.

Attest: JOHN N. HOLTON, Secy.

A SAFETY DEVICE FOR TROLLEY WIRES.

One reads in the daily press of so many accidents due to the breaking of trolley wires that interest is aroused by each new device for the prevention of the resultant injuries and fatalities.

One of the latest forms, having some advantages of simplicity, is that brought out by Mr. Geo. F. Cole, of Chicago, Ill.*

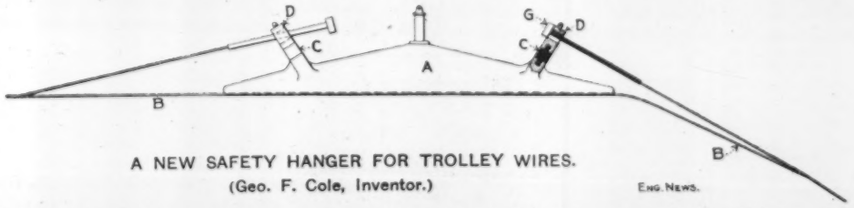
It is best shown by reference to the accompanying figure. The hanger A, supporting the trolley wire B, is an adaptation of the standard overhead construction. Two insulating fingers, C C, are carried by the hangers, as shown, with a contact piece, D D, fitted on the end of each. Through a hole in each contact piece and supporting finger is passed a copper wire attached to the main trolley, both electrically and mechanically. These wires are insulated from the contact pieces, D D, by a proper sleeve, and carry a metal head or contact knob, G, which is normally in the position shown at the left-hand finger, and not in contact with the piece D.

However, when the trolley wire breaks at or close to the span which carries this arrangement, it drops or causes such a sag in adjacent spans that the head G is brought into contact with D. If now D is connected to earth by suitable wires through a proper switch or circuit breaker, the breaking of the wire can operate the arrangement so as to automatically disconnect that section from the supply.

These devices would be located at such a distance apart that should the wire break midway between them the sag in the span at the device would be sufficient to operate it. Use of such a device might necessitate dividing the overhead lines into sections half or three-quarters of a mile long, which would not seem difficult. The device would, of course, be installed on the most frequented streets, principal cross lines, and where experience had shown some such safety device to be desirable.

Patents have been applied for on this device, and it is under consideration by several street railway engineers for adoption. We are indebted to the inventor for the information herein given.

*P. O. Box 539, Chicago, Ill.

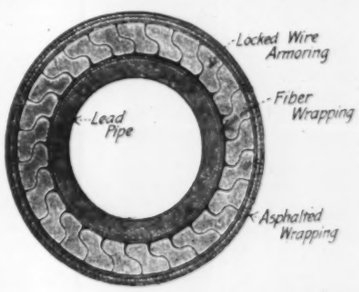


A NEW SAFETY HANGER FOR TROLLEY WIRES.
(Geo. F. Cole, Inventor.)

ENG. NEWS.

ARMORED FLEXIBLE WATER PIPE FOR SUBAQUEOUS CONDUIT.

A locked-wire armoring such as is used on electric cables and on certain kinds of power-transmission rope has been applied very ingeniously to produce flexible piping. Such wire laid up helically like a rope around a core, forms a tube having considerable strength while retaining some amount of flexibility. In this shape it is used with great success as armoring on electric cables, mainly on submarine telephone and telegraph cables, where it protects gutta-percha or rubber core from external injury and from internal stress. When laid up around a lead pipe it similarly serves to protect the pipe from injury, to preserve its shape, and to take the longitudinal and bending stresses which arise in the necessary handling of the pipe. The pipe thus protected can be laid in water, on irregular bottom, without special precautions, under conditions which now call for either flexible-joint pipe or, if rigid pipe is used, a trench carefully excavated to a uniform grade. The ease of laying and jointing this new kind of pipe must prove an important factor in the cost of the line, in addition to the saving produced by the elimination of spherical joints and dredged trenches.



Cross-Section of Armored Flexible Water Pipe for Subaqueous Mains.
(Made by Felten & Guilleaume-Lahmeyer Works.)

The Felten & Guilleaume-Lahmeyer Works, of Mülheim-on-Rhine, Germany, are making pipe of this description, as illustrated by the cross-section herewith, under a patent covering the combination of metal tubing with a hollow cabling of shaped wire. A cushioning layer is interposed between the pipe core and the armor, for obvious purpose, and in sea-water, or otherwise where corrosion is to be apprehended, a double layer of asphalted wrapping is put around the armor. Such pipe may be made in great lengths, limited by the greatest weight of reel which can be transported and handled. A simple flange joint is provided for connecting successive lengths at the site of laying. The pipe has been made in sizes up to 2⁹/₁₆ ins. inside diameter, but it is claimed that the manufacture of larger sizes, 3-in. and over, involves no serious difficulties.

Three such pipes, each 1,350 ft. long, were laid in a crossing at Amsterdam, Holland, ten years ago; the laying took only 35 mins. These pipes have been in constant use since then, supplying water to part of the city of Amsterdam. Rio de Janeiro, Brazil, has also laid some pipe of this kind. About 6 miles of 2⁹/₁₆-in. pipe are now being manufactured for the latter city, to carry potable water to several islands in the bay. In this case the lead pipe has a wall-thickness of ¼-in. and is tinned inside. The pipe is being furnished in lengths of 650 ft. on reels, the shipping weight per reel being about 8 tons. (Zeitschrift des Vereines Deutscher Ingenieure, July 27, 1907.)

TENSION TESTS OF STEEL ANGLES WITH VARIOUS TYPES OF END-CONNECTION.*

By FRANK P. McKIBBEN.†

The tests which form the subject of this paper were made upon 33 steel angles such as are used for tension members in riveted framed structures. They are a continuation of a series made at the Massachusetts Institute of Technology in 1906 (Eng. News, July 5, 1906, p. 14). This series of tests (begun last year and not yet completed) has been undertaken with a view of studying the following points:

(1) The ultimate strength of the angles in tension.

(2) The value of a lug in transmitting stress from the outstanding leg of the main angle into the hitch plate.

(3) The relative strength of angles where the gage line for rivets and where the center-of-gravity line, respectively, pass through the center of the pull.

(4) The effect of the position of the rivets connecting the main angles to the hitch plates.

(5) The relative strength of single angles and angles riveted together to form pairs.

(6) The effect, upon the strength of the specimen, of the different methods of holding the specimen in the testing machine.

In the series tested this year there are three specimens of each of ten different types, also three specimens which differ from one another and from one of the ten types only slightly. This makes thirty-three angles in all. These are shown in detail in Fig. 1. Each of the main angles, 5 ft. 4 ins. in length, is riveted at each end to a hitch plate.

The description of the different types tested is as follows:

A_3: One $3\frac{1}{2} \times 3 \times \frac{3}{8}$-in. angle, connected at each end by six rivets, three in each leg, with lugs; and with the gage line passing through the center of pull.

A_4: same as A_3, except with center-of-gravity line, in plan, passing through center of pull.

A_5: same as A_4, but with thicker lug angles.

B_4: similar to A_4, but with $4 \times 3 \times \frac{3}{8}$-in. main angles.

B_5: similar to B_4, but with center of pull passing in plan $\frac{5}{8}$-in. from back of vertical leg.

B_6, B_7, B_8: same as B_4, but with staggers between the two inner rivets decreasing successively by $\frac{1}{4}$-in.

C_3: One $6 \times 4 \times \frac{3}{8}$-in. angle connected to each hitch plate by nine rivets staggered in two rows in the 6-in. leg, but with both inner rivets on the gage line nearest the back of the angle. Center of gravity line passes through center of pull.

C_4: same as C_3, except that the two inner rivets are staggered, instead of on the same gage line.

C_5: similar to C_4, but with lugs; six rivets in 6-in. leg and three rivets in 4-in. leg at each plate.

D_3: Two $3 \times 3 \times \frac{3}{8}$-in. angles, one on each side of the hitch plate, and connected without lugs to each plate by six rivets all in one row. The center of gravity line passes through center of pull.

D_4: similar to D_3, but with lugs; each main angle is connected at either end with 3 rivets in each leg.

Improvements upon the types of connections used in the 1906 series of tests were attempted in the following ways: (1) By increasing the stagger between the two inner rivets, in cases where there were rivets in both legs of the angle, until the minimum net zigzag area of the angle through two rivets was at least equal to the net right section. (2) By placing the two inner rivets on the inner gage line in specimens having two rows of rivets in the leg connecting with the hitch plate. (3) By applying the pull to the specimen through the center of gravity line of the angle in plan. (4) By using thicker lug angles.

The connections of the angles to the hitch plates were so designed as to insure failure in the angles rather than in the rivets or connecting plates. The hitch plate at each end of each specimen was provided with two 2-inch holes, by means of which it was pinned between two holding plates which in turn were connected by a single pin to a third plate gripped by the testing machine. (Eng. News, July 5, 1906, p. 14). It should be borne in mind that the holding device is a flexible joint, and is not the rigid connection more commonly found in structures in which angles are used as tension members. The method of holding the ends has an important bearing on the strength of the angles, and the presence of this flexible joint should not be lost sight of in studying the results of the tests thus far made. The writer hopes to make further tests in which a rigid connection is to be used.

Table 1 gives the results of the physical tests of small tensile test bars which were cut from the long angles out of which were taken the main angles of the specimens tested this year. In most cases three such test bars were taken from each long angle but in two cases only two bars were secured from each long angle. On all of these test pieces the yield point was determined by the drop of the beam and also by measurement with dividers.

TABLE I.—PHYSICAL PROPERTIES OF METAL OF ANGLES USED IN 1907 TESTS.

Test piece.	Yield point, Lbs. per sq. in.	Ultimate strength, Lbs. per sq. in.	Elongation, % in 8 ins.	Reduction of area, %
AA3, AA4	35,500	57,900	29.1	57.9
	35,500	57,800	28.6	53.2
	35,300	57,600	28.6	54.7
Mean	35,400	57,800	28.8	55.0
AA5	36,100	56,500	29.6	56.2
	34,700	56,600	29.0	54.5
	34,700	56,500	28.9	49.7
Mean	35,200	56,500	29.2	53.5
BB4, BB5, BB7	35,000	53,500	29.2	58.6
	34,300	53,400	31.0	59.5
	35,100	54,000	30.9	58.2
Mean	34,800	53,600	30.7	58.7
BB6, BB8	35,400	59,500	27.0	50.4
	33,700	60,000	28.0	48.6
	36,900	59,900	27.4	54.4
Mean	35,300	59,800	27.5	51.1
CC3, CC4, CC5	36,900	59,800	31.3	55.2
	37,600	59,300	27.1	54.1
	38,400	59,600	27.9	54.7
Mean	37,600	59,600	28.8	55.4
DD3	39,000	60,200	25.9	49.2
	38,900	59,600	26.8	51.2
Mean	39,000	59,900	26.4	50.3
DD4	38,400	58,800	30.3	50.8
	39,100	58,800	28.5	56.5
Mean	38,800	58,800	29.4	53.7

NOTE: The test-pieces were approximately ½-sq. in. in cross-section (0.455 to 0.573-sq. in.).

Table 2 is a summary of the tests of the specimens in this table: Nos. 1 to 27 inclusive are those tested in 1906 and previously published, and Nos. 28 to 60 inclusive are those tested this year. The figures in the columns headed "Percent of Ultimate Strength Developed" are

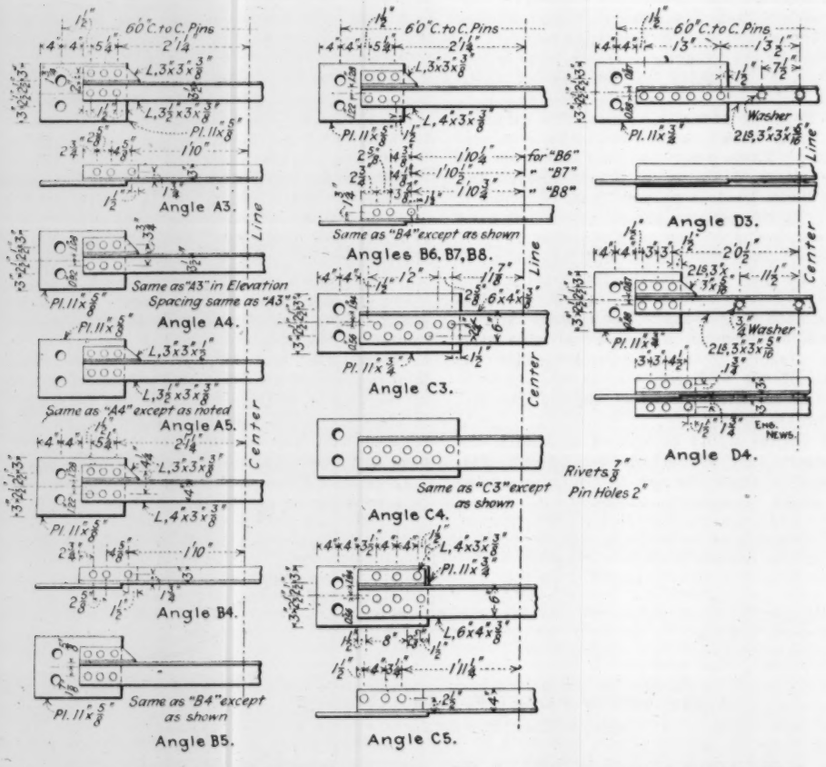


FIG. 1. TEST SPECIMENS USED IN 1907 TENSION TESTS OF STEEL ANGLES.

Note: Three specimens of each type were tested, except B_6, B_7 and B_8, which were represented by only one specimen each.

Angles and plates were of medium steel, Manufacturers' Standard. All angles of a given size were cut from one long angle. All rivets were of rivet steel, ⅞-in. diameter, holes punched $^{15}/_{16}$-in. Pin-holes were drilled to 2-in. diameter.

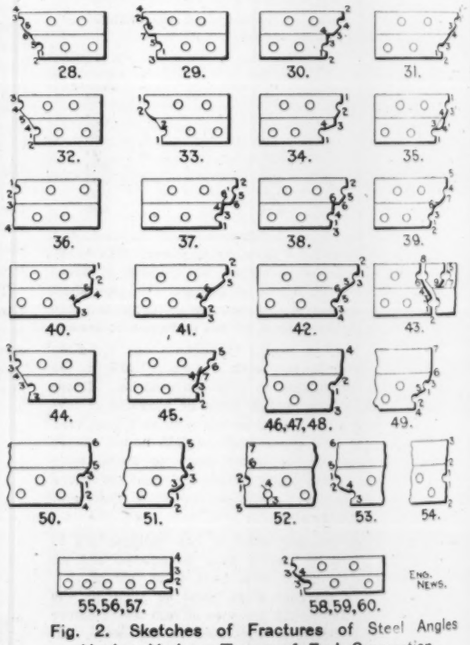


Fig. 2. Sketches of Fractures of Steel Angles Having Various Types of End Connection.

Note: Small figures at fractures denote origin and progress of rupture. The lower portion of each sketch represents the leg connected to the hitch-plate.

In Fig. 2 are shown diagrammatically the outlines of the fractures, all of which occurred in the main angles. The numbers on the sketches indicate the sequence of the ruptures. With the exception of specimen 57, made of two $3 \times 3 \times 5$-16-in. angles, failure occurred at one of the inner rivets which connects the main angle to the hitch plate, that is the connecting rivet which lies nearest to the center of the specimen. In the case of specimen 57 one of the angles failed at the inner connecting rivet, but the other angle failed at the first tack rivet 8 ins. from the inner rivet. In every case the fracture started at a rivet. In the majority of cases of specimens having lugs, failure occurred on a zigzag section passing through rivets in the horizontal and in the vertical legs. This was the case even though the minimum net zigzag section was slightly larger than the net right section, as for example, specimens 31, 32, 33. In some of the specimens having the two net sections just mentioned nearly equal, for instance specimens 35 and 37, the fracture really occurred on the zigzag section but it also started on the right section. Failure occurred on the right section in some cases. In many specimens the angle failed by shearing on the diagonal section between the inner rivets in the horizontal and in the vertical legs after the metal between these rivets and the outer edges of the legs had been broken. The fractures were all silky. In specimen 50 a slight flaw was detected after failure at the inner rivet in the leg attached to the plate. The specimens made of two angles failed more suddenly than those made of one.

*A paper read before the American Society for Testing Materials at Atlantic City, N. J., June 22, 1907.

†Assistant Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

TABLE II.—SUMMARY OF TENSION TESTS OF STEEL ANGLES, 1906 AND 1907.

Type	No. of specimen.	Nominal dimensions.	Areas in square inches: Actual gross.	Net right. $\frac{13}{16}$" holes.	Net right. 1" holes.	Least net Zigzag $\frac{13}{16}$" holes.	Least net Zigzag 1" holes.	Total breaking load in lbs.	Breaking loads in lbs. per square inch: Actual gross area.	Net right section, $\frac{13}{16}$" holes	Net right section, 1" holes.	Least net Zigzag $\frac{13}{16}$" holes.	Least net Zigzag 1" holes.	Per cent. of ultimate strength developed.*: Actual gross area.	Net right section $\frac{13}{16}$" holes.	Net right section 1" holes.	Least net Zigzag $\frac{13}{16}$" holes.	L'st net Zigzag 1" holes.
1906 TESTS:																		
A1	1	3½" × 3" × ⅜"	2.29	1.95	1.93	....	....	89,500	39,100	45,900	46,400	.....	.....	65.9	77.4	78.3	....	....
	2		2.32	1.97	1.95	....	....	96,100	41,400	48,800	49,300	.....	.....	69.8	82.3	83.2	....	....
	3		2.35	2.00	1.98	....	....	95,200	40,500	47,600	48,100	.....	.....	68.3	80.3	81.1	....	....
	Mean		2.32	1.97	1.95	....	....	93,600	40,300	47,400	47,900	.....	.....	68.0	80.0	80.9	....	....
A2	4	3½" × 3" × ⅜"	2.28	1.94	1.92	1.67	1.63	84,600	37,100	43,600	44,000	50,600	51,500	62.5	73.6	74.3	85.4	87.6
	5		2.31	1.97	1.94	1.69	1.64	88,600	38,300	45,000	45,600	52,400	54,000	64.5	76.0	77.0	88.4	91.1
	6		2.27	1.93	1.91	1.66	1.61	91,200	40,200	47,200	47,700	54,900	56,600	67.8	79.6	80.5	92.7	95.5
	Mean		2.29	1.95	1.92	1.67	1.63	88,100	38,500	45,300	45,800	52,600	54,200	64.9	76.4	77.3	88.8	91.4
B1	7	4" × 3" × ⅜"	2.43	2.10	2.07	....	....	85,000	35,000	40,500	41,100	.....	.....	64.8	75.0	76.1	....	....
	8		2.42	2.09	2.06	....	....	84,000	34,700	40,200	40,800	.....	.....	64.2	74.5	75.6	....	....
	9		2.50	2.15	2.13	....	....	85,600	34,200	39,800	40,200	.....	.....	63.3	73.7	74.5	....	....
	Mean		2.45	2.11	2.09	....	....	84,900	34,600	40,200	40,700	.....	.....	64.1	74.4	75.4	....	....
B2	10	4" × 3" × ⅜"	2.42	2.09	2.06	1.82	1.76	83,500	34,500	39,900	40,500	45,900	47,400	63.9	73.9	75.0	85.0	87.8
	11		2.43	2.09	2.07	1.81	1.76	85,100	35,000	40,700	41,100	47,000	48,400	64.8	75.4	76.1	87.1	89.7
	12		2.45	2.11	2.08	1.86	1.81	84,100	34,300	39,900	40,400	45,200	46,500	63.5	73.9	74.8	83.7	86.1
	Mean		2.43	2.10	2.07	1.83	1.78	84,200	34,600	40,200	40,700	46,000	47,400	64.1	74.4	75.3	85.3	87.9
B3	13	4" × 3" × ⅜"	2.40	2.07	2.04	....	....	88,600	36,900	42,800	43,400	.....	.....	68.3	79.3	80.3	....	....
	14		2.42	2.09	2.06	....	....	90,400	37,300	43,200	43,800	.....	.....	69.0	80.0	81.1	....	....
	15		2.41	2.07	2.05	....	....	91,000	37,800	44,000	44,400	.....	.....	70.0	81.5	82.2	....	....
	Mean		2.41	2.08	2.05	....	....	90,000	37,300	43,300	43,900	.....	.....	69.1	80.3	81.2	....	....
C1	16	6" × 4" × ⅜"	3.53	3.17	3.15	3.11	3.06	131,000	37,100	41,300	41,600	42,100	42,800	71.9	80.0	80.7	81.6	82.9
	17		3.54	3.18	3.16	3.12	3.07	125,700	35,500	39,500	39,700	40,300	40,900	68.8	76.6	76.9	78.1	79.3
	18		3.50	3.14	3.12	3.07	3.03	128,200	36,600	40,800	41,100	41,800	42,300	70.9	79.1	79.7	81.0	82.0
	Mean		3.52	3.16	3.14	3.10	3.05	128,300	36,400	40,500	40,800	41,400	42,000	70.5	78.6	79.1	80.2	81.4
C2	19	6" × 4" × ⅜"	3.50	3.20	3.17	2.90	2.83	131,500	37,600	41,100	41,500	45,300	46,500	72.9	79.7	80.4	87.8	90.1
	20		3.50	3.19	3.17	2.89	2.82	130,200	37,200	40,800	41,100	45,000	46,200	72.1	79.1	79.7	87.2	89.5
	21		3.50	3.19	3.17	2.89	2.82	131,900	37,700	41,300	41,600	45,600	46,800	73.0	80.1	80.7	88.4	90.7
	Mean		3.50	3.19	3.17	2.89	2.82	131,200	37,500	41,100	41,400	45,300	46,500	72.7	79.6	80.3	87.8	90.1
D1	22	2-3" × 3" × 5/16"	3.44	2.88	2.84	....	....	134,100	39,000	46,600	47,200	.....	.....	64.0	76.4	77.4	....	....
	23		3.43	2.87	2.83	....	....	136,500	39,800	47,600	48,200	.....	.....	65.2	78.1	79.0	....	....
	24		3.50	2.92	2.88	....	....	139,100	39,800	47,700	48,300	.....	.....	65.2	78.2	79.2	....	....
	Mean		3.46	2.89	2.85	....	....	136,600	39,500	47,300	47,900	.....	.....	64.8	77.6	78.5	....	....
D2	25	2-3" × 3" × 5/16"	3.43	2.87	2.83	2.48	2.41	137,900	40,100	48,000	48,700	55,600	57,200	65.7	78.7	79.8	91.2	93.8
	26		3.43	2.87	2.83	2.47	2.40	140,400	40,900	48,900	49,600	56,800	58,500	67.0	80.2	81.3	93.1	95.9
	27		3.42	2.86	2.82	2.46	2.39	138,800	40,600	48,500	49,200	56,400	58,100	66.6	79.5	80.6	92.5	95.2
	Mean		3.43	2.87	2.83	2.47	2.40	139,000	40,500	48,500	49,200	56,300	57,900	66.4	79.5	80.6	92.3	95.0
	1907 TESTS:																	
A3	28	3½" × 3" × ⅜"	2.24	1.91	1.89	1.96	1.92	94,400	42,100	49,400	49,900	48,100	49,200	72.9	85.5	86.5	83.2	85.1
	29		2.26	1.93	1.91	1.98	1.94	96,900	42,900	50,200	50,700	48,900	49,900	74.3	86.9	87.8	84.6	86.3
	30		2.25	1.92	1.90	1.98	1.93	98,200	43,600	51,100	51,700	49,600	50,900	75.5	88.5	89.5	85.9	88.0
	Mean		2.25	1.92	1.90	1.97	1.93	96,500	42,900	50,200	50,800	48,900	50,000	74.2	87.0	87.9	84.6	86.5
A4	31	3½" × 3" × ⅜"	2.27	1.93	1.91	1.99	1.94	99,600	43,900	51,600	52,100	50,000	51,400	76.0	89.3	90.2	86.5	89.0
	32		2.23	1.91	1.89	1.96	1.91	97,300	43,600	51,000	51,500	49,600	51,000	75.5	88.3	89.1	85.9	88.2
	33		2.25	1.92	1.90	1.97	1.93	99,200	44,100	51,700	52,200	50,400	51,400	76.3	89.5	90.4	87.1	89.0
	Mean		2.25	1.92	1.90	1.97	1.93	98,700	43,900	51,400	51,900	50,000	51,300	75.9	89.0	89.9	86.5	88.7
A5	34	3½" × 3" × ⅜"	2.27	1.93	1.91	1.98	1.94	97,600	43,000	50,600	51,100	49,300	50,300	76.1	89.6	90.5	87.3	89.1
	35		2.28	1.95	1.93	2.00	1.96	98,500	43,200	50,500	51,000	49,300	50,300	76.5	89.5	90.3	87.3	89.1
	36		2.26	1.92	1.90	1.98	1.94	97,900	43,300	51,000	51,500	49,500	50,500	76.6	90.3	91.2	87.6	89.4
	Mean		2.27	1.93	1.91	1.99	1.95	98,000	43,200	50,700	51,200	49,400	50,400	76.4	89.8	90.7	87.4	89.2
B4	37	4" × 3" × ⅜"	2.41	2.08	2.06	2.10	2.06	100,400	41,700	48,300	48,800	47,900	48,800	77.9	90.1	91.0	89.3	91.0
	38		2.40	2.06	2.04	2.08	2.04	98,300	41,000	47,700	48,200	47,200	48,200	76.5	89.0	90.0	88.0	90.0
	39		2.43	2.10	2.08	2.12	2.07	101,400	41,700	48,300	48,800	47,800	49,000	77.9	90.1	91.0	89.2	91.5
	Mean		2.41	2.08	2.06	2.10	2.06	100,000	41,500	48,100	48,600	47,600	48,700	77.4	89.7	90.7	88.8	90.8
B5	40	4" × 3" × ⅜"	2.39	2.06	2.04	2.09	2.04	100,500	42,000	48,800	49,300	48,100	49,300	78.4	91.0	92.0	89.8	91.9
	41		2.41	2.08	2.06	2.11	2.06	103,500	42,900	49,800	50,200	49,000	50,200	80.1	92.9	93.7	91.5	93.7
	42		2.48	2.14	2.12	2.16	2.12	104,500	42,100	48,800	49,300	48,300	49,300	78.6	91.0	92.0	90.1	91.9
	Mean		2.43	2.09	2.07	2.12	2.07	102,800	42,300	49,100	49,600	48,500	49,600	79.0	91.6	92.6	90.5	92.5
B6	43	4" × 3" × ⅜"	2.39	2.06	2.04	2.03	1.99	100,600	42,000	48,900	49,300	49,500	50,500	70.3	81.8	82.5	82.8	84.4
B7	44		2.44	2.10	2.08	2.03	1.98	103,500	42,400	49,300	49,800	51,000	52,300	79.1	92.0	92.9	95.1	97.6
B8	45		2.40	2.06	2.04	1.95	1.90	101,800	42,400	49,400	49,900	52,200	53,500	70.9	82.6	83.5	87.3	89.5
C3	46	6" × 4" × ⅜"	3.60	3.24	3.22	....	....	154,600	42,900	47,700	48,000	.....	.....	72.0	80.0	80.5	....	....
	47		3.56	3.20	3.18	....	....	150,600	42,300	47,000	47,300	.....	.....	71.0	78.8	79.4	....	....
	48		3.58	3.22	3.20	....	....	153,300	42,800	47,600	47,900	.....	.....	71.8	79.9	80.3	....	....
	Mean		3.58	3.22	3.20	....	....	152,800	47,700	47,400	47,700	.....	.....	71.6	79.6	80.1	....	....
C4	49	6" × 4" × ⅜"	3.56	3.21	3.18	3.31	3.26	150,600	42,300	46,900	47,300	45,500	46,200	71.0	78.6	79.4	76.3	77.5
	50		3.54	3.19	3.16	3.29	3.24	144,100	40,700	45,200	45,600	43,800	44,500	68.3	75.9	76.5	73.5	74.6
	51		3.54	3.19	3.17	3.29	3.25	152,200	43,000	47,700	48,000	46,300	46,800	72.1	80.0	80.5	77.6	78.5
	Mean		3.55	3.20	3.17	3.30	3.25	149,000	42,000	46,600	47,000	45,200	45,800	70.5	78.2	78.8	75.8	76.9
C5	52	6" × 4" × ⅜"	3.54	3.18	3.16	3.20	3.16	143,500	40,500	45,100	45,400	44,800	45,400	68.0	75.7	76.1	75.1	76.1
	53		3.53	3.18	3.16	3.20	3.15	148,000	41,900	46,500	46,800	46,300	47,000	70.2	78.0	78.5	77.6	78.9
	54		3.51	3.16	3.14	3.18	3.13	146,400	41,800	46,300	46,600	46,000	46,700	70.1	77.7	78.2	77.1	78.5
	Mean		3.53	3.17	3.15	3.19	3.15	146,000	41,400	46,000	46,300	45,700	46,400	69.4	77.1	77.6	76.6	77.8
D3	55	2-3" × 3" × 5/16"	3.43	2.88	2.84	....	....	140,000	40,800	48,600	49,300	.....	.....	68.1	81.2	82.4	....	....
	56		3.39	2.83	2.79	....	....	140,700	41,500	49,700	50,400	.....	.....	69.3	82.9	84.2	....	....
	57		3.39	2.83	2.79	....	....	140,600	41,500	49,600	50,300	.....	.....	69.3	82.9	84.0	....	....
	Mean		3.40	2.85	2.81	....	....	140,400	41,300	49,300	50,000	.....	.....	68.9	82.3	83.5	....	....
D4	58	2-3" × 3" × 5/16"	3.38	2.83	2.80	2.87	2.80	135,600	40,100	47,900	48,400	47,200	48,400	68.2	81.5	82.3	80.3	82.3
	59		3.34	2.79	2.76	2.84	2.76	134,800	40,300	48,300	48,800	47,500	48,800	68.5	82.1	83.0	80.8	83.0
	60		3.37	2.82	2.78	2.87	2.78	130,000	38,600	46,100	46,800	45,300	46,800	65.5	78.5	79.5	77.0	79.6
	Mean		3.36	2.81	2.78	2.86	2.78	133,500	39,700	47,400	48,000	46,700	48,000	67.4	80.7	81.6	79.4	81.6

*Figures of five preceding columns compared with results of test bars.

obtained by dividing the strength per squarch inch in the specimen by the ultimate strength per square inch of the small test bars and multiplying by 100 to reduce to a percentage basis. Net areas have been computed under the assumption that the holes are 15-16-in. in diameter and again that they are 1-in. in diameter. The least zigzag sections have been computed by assuming the angles to be developed about the corners and taking the net areas on a section passing from the edges of the legs to the centers of the inner rivet holes, then diagonally between centers of rivets. In the results published last year the net areas given were not the least zigzag areas, but were those computed on sections which approximated the fractured sections. In the accompanying table last year's tests have been revised so that the net zigzag areas shown are the least that can be obtained for those tests.

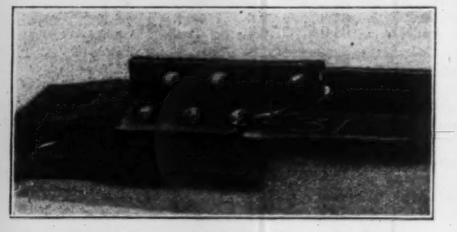
In studying the results of these tests it should be remembered that the ends of the specimens are not held rigidly in the testing machine and that there are a comparatively small number of angles of any one kind. However, the results so far as they go should be studied with a view of determining the most efficient connection. The efficiency of a specimen may be based upon its gross area or upon its minimum net area. This latter area may be either that of a right section or that of a zigzag section. On the whole it seems most reasonable to base the efficiency on the gross area of the angle, so that if we have a series of angles of the same size, gross cross-section and quality but with different end connection, that connection is the most efficient which will allow the angle to carry the maximum load.

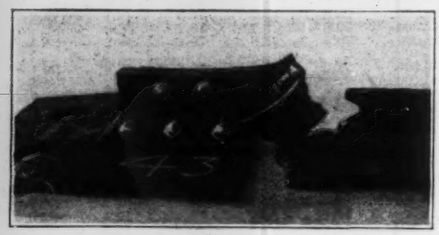
Basing our study therefore on the stress per square inch of gross area of the angles, and considering all of the angles of a given size, the tests seem to show that for the 3½ × 3 × ⅜-in. angles the greatest efficiency, 76.4%, occurs with those angles, with lugs, having the pull passing through the center of gravity of the angle in plan. Inasmuch as the efficiencies of the specimens A_3, A_4 and A_5 are about the same, and are much greater than those of A_1 and A_2 tested last year, it appears that this gain in efficiency is due largely to the increased stagger of the inner rivets in the two legs of the angles. The importance of this stagger is seen by comparing A_3 and A_2. Of the specimens A_3, A_4 and A_5 the last two, both of which have the center of pull coinciding with the center of gravity instead of with the gage line, show the greatest efficiency.

For the 4 × 3 × ⅜-in. angles the greatest efficiency is obtained from B_4 and B_6, which make a much better showing than the angles of the same size tested last year. The advantage of having the large stagger between the inner rivets of the two legs will be noticed by comparing an efficiency of 77.4% for B_4 with an average of 73.4%

for B_6, B_7 and B_8. In B_4 the average net right section is less than the average net zigzag section, while for B_6, B_7 and B_8 the reverse is true.

For the $6 \times 4 \times \frac{5}{8}$-in angles the greatest efficiency for this year's tests is shown for C_3, which has no lugs, has the first two rivets on the same gage line, and has the line of pull through the center of gravity of the specimen. However, a slightly better showing was made by C_2 of





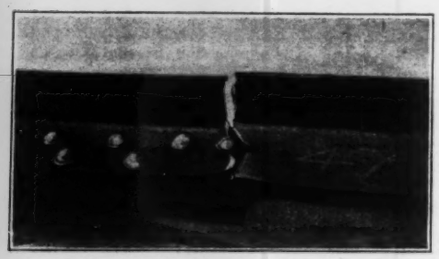


Fig. 3. Three Typical Fractures.
Specimens 31 (A4), 43 (B6) and 47 (C3).

last year's series. C_2 had lugs and had the center of pull passing through the inner gage line of the main angle.

Of the specimens composed of two $3 \times 3 \times 5$-16-in. angles the greatest efficiency is shown by this year's tests with 68.9% for D_3, which has no lugs and has the center of pull passing through the center of gravity of the angles.

SPECIAL REPORT OF THE CITY ENGINEER OF SEATTLE, WASH.

Some months ago, Mr. R. H. Thomson, M. Am. Soc. C. E., City Engineer of Seattle, was instructed by ordinance to visit American and foreign cities for the purpose of investigating sewage and garbage disposal. He was also instructed to gather information of possible value to the city regarding other municipal services. Mr. Thomson has very kindly sent us a typewritten copy of his report, from which we have extracted certain points likely to be of interest to our readers.

SEWAGE TREATMENT.—After outlining his visits to various European sewage works and describing a number of the works which he saw, Mr. Thomson states in his report that on comparing local conditions with the results of his observations abroad he has concluded "that for a long time to come, the most economical method for the disposal of" the sewage of Seattle "will be by means of dilution in sea-water." It is probable that various changes and improvements in outfalls will be necessary, and it may be that partial treatment will be required at some points in the future. The local problem in sewage disposal has been altered and complicated of late by natural and artificial diversions of some of the streams tributary to the waters surrounding Seattle, which streams would naturally serve to dilute the sewage.

GARBAGE AND REFUSE DISPOSAL.—Both European and American garbage and refuse disposal plants were visited by Mr. Thomson and a number of these are described in the report. We quote Mr. Thomson's notes on the garbage reduction plants at Vincennes, Ind., and Toledo, O.

GARBAGE REDUCTION AT VINCENNES, IND., AND TOLEDO, O.—Inasmuch as the plants at Vincennes and Toledo are claimed to be among the most modern and up-to-date of those designed to make a profit by the use of by-products, I will more particularly describe them than any others of that type. The Vincennes plant is one in which all refuse taken to it is put in great cast-iron cylinders, holding about six tons each, which are heated by a steam jacket to such a temperature that all the grease is fully separated. After the extraction of the grease, the remaining part is first desiccated and then reduced to fertilizer. This city has a population of 12,000 people, and there is a considerable portion of the city which still uses the old-fashioned swill barrel, which prevails in semi-rural communities. During 1905, there was collected in this city of 12,000 people, each week day, a little over 6,000 lbs. of swill, and from three to six dead animals. These were delivered to the plant at the cost of the city. The plant is operated by two men. The by-products are hides, grease and dry tankage. The men affirmed that the amount of grease rendered was about 2%, by weight, of the garbage received, and that the grease sold upon the market to soap manufacturers at from 2½ to 3 cts. per lb. They reported the tankage, from which fertilizer is made, as being about 20%, by weight, of the material received. At times ammonia is extracted from the tankage, which is said to produce from 2¾ to 3½% of the same, and which has a sale value varying from $5.20 to $8.75 per ton. From 4 to 6% of the tankage is at times converted into phosphoric acid, from which 1½% of potash is also recoverable. For the operation of this type of reduction plant, the manufacturers claim that by rule of thumb we should figure that about 1 HP. of energy would be necessary for operating purposes to each 1,000 people served. The weighing of the refuse handled at Vincennes indicated that it varied between 30 and 42 lbs. per cu. ft. As nearly as I could estimate the cost of the appliances, I determined that it would be necessary to estimate an expenditure of 50 cts. per capita of a city's population for the machinery to be used, exclusive of the cost of buildings, grounds, sewer connections and things of that kind, and that, exclusive of the men engaged in the collection of the materials, there would be required in the operation of the plant, practically one man for every 6,000 population. That is to say, that if the city of Seattle were to be fully equipped with reduction plants of the Vincennes type, the original installation for machinery alone, exclusive of buildings, grounds, sewer connections, etc., would be about $120,000, and the cost of operation, exclusive of fuel and light, would be $120 per day. I have not attempted to make any careful estimate of the additional cost of collecting and delivering such waste in the city of Seattle, but it would be a very great sum.

At Toledo, I found an Edson reduction plant located just at the edge of the city, which had been in operation about three months only, at the time of my visit. In this place, the city collects and delivers to the plant the garbage and dead animals found in the city. By garbage is meant the slop and swill from the kitchen, excluding all crockery, cans, etc., and, with the exception of bones, this garbage may all be termed to be perishable or putrescible matter. The company claimed to be serving a population of 175,000 people, and, as near as I could determine from the weights, there was approximately 70 tons per day being delivered to the plant.

The by-products from this reduction plant are but two. First, grease, and so far as I could learn, the production was about 2% of the weight of garbage received. Second, dry tankage, the whole of which is reduced to fertilizers, for which there is a ready sale. The fertilizer is put up in a number of forms, according to the purposes for which it is intended to be used. A large percentage of it is ground together with phosphate rock and is used for fertilizing grain fields, a tank of the fertilizer being carried over the drills and so arranged as to discharge a fine stream through each drill-tube, with the grain. A considerable percentage of the fertilizer is put up in fancy sacks and labeled as a guano, and sold to gardeners to be worked about the roots of plants.

I found considerable difference of opinion amongst fertilizer dealers as to the relative merits of this fertilizer as compared with finely pulverized plain phosphate rock, Learning of a community in Indiana where large quantities of both classes of fertilizer had been used in a successful farming district under careful inspection I visited the same and made careful inquiry as to the comparative results of such use. I also discussed the matter with several professors of agriculture in liberal institutions. After a somewhat tedious investigation, I was forced to the conclusion that there was no absolutely accurate or definite results which I could quote, but I think the preponderance of the testimony justifies the conclusions that:

(1) Where phosphate rock is used unmixed with any other material, it tends to render the ground slightly sticky or like a limestone clay.

(2) That where phosphate rock is mingled in the ordinary proportions with pulverized dry tankage, the ground retains its natural and ordinary texture, and

(3) That in proportion to the cost of the material used, there is no great difference in the value of the two kinds of fertilizer; if anything, the plain phosphate rock being a little more productive than the mixture.

Afetr the most careful inquiry as to the financial results attending the Toledo plant, I could only elicit this statement: The company claims a return equal to the cost of maintenance, betterments and interest. Privately, persons claiming to know definitely, affirm that the profits are not commensurate with the outlay. This statement I am unable to verify.

CHARACTER OF FOREIGN REFUSE.—As to the combustibility of the refuse of foreign countries, Mr. Thomson may be quoted as follows:

The character of the refuse presented at the various destructors throughout the world was carefully examined by me with reference to its combustibility. In my judgment, the least combustible was that seen in Germany, the most combustible, that in central England. In Germany, a great portion of the coal is briquetted, and the ash produced is almost without carbon. There is but little waste also from the German housewife's kitchen. In central England, the cheaper grades of coal are used in the homes and the fires are commonly maintained over rather open grates, thus allowing much carbon-bearing matter to fall through. English housewives also are less careful than the German. There is no such thing as a standard of waste, but careful examination of many tons of that handled at Seattle shows that there is in it much carbon, and it should burn readily and completely, without the addition of a particle of other fuel, the destructor being built by the city.

DESTRUCTORS FOR SEATTLE.—Mr. Thomson's final conclusions as to refuse disposal were in favor of destructors or burning, rather than reduction plants, although he states that in the future it might be desirable to build a reduction plant in connection with some one of the five destructors recommended. He notes that the city of Glasgow proposes to add to its destructor plants until it reaches a total of 14, so located "as to reduce the maximum haul to 1 mile and the average haul to 0.6-mile."

PATENTS.—It is interesting to note, in passing, Mr. Thomson's statement of the fact that nearly every official abroad at the head of a department charged with street cleaning and refuse disposal "is a patentee of several devices which he thinks essential to the public health, though strangely enough" he did not find any second person using these patented articles.

PAVEMENTS.—As to pavements, Mr. Thomson found the same general practice in the matter of foundations as prevails in this country; that is, the use of a 4 to 9-in. concrete base, varying with local conditions. For very heavy traffic he found granite used almost exclusively. The blocks, as a rule, were 3½ ins. square and 6 ins. long, set on end. The small size of the blocks aids in giving a better foothold, diminishes the tendency to rounding, and lessens the noise. Where neither stone blocks nor macadam are used, wooden blocks are generally employed, rather than asphalt. The life claimed for wooden blocks by the engineers of different cities showed a considerable range, varying from 12 to 15 years for Edinburgh, to 3½ years in Paris.

Macadam is of course used extensively. Mr. Thomson states that he found no engineer who was willing to give "substantial praise" to tar macadam. Of the "innumerable patented liquids" for treating roads to prevent dust, Mr. Thomson gives as his judgment that "they are all of doubtful value," but he adds that "they have a large sale."

FIRE DEPARTMENTS.—Mr. Thomson seemed to be much impressed with the relatively small fire losses and low cost of operating the fire departments of European cities. A number of pages of his report are devoted to an interesting review of some of the European fire departments, particularly those in which the police and fire departments are virtually the same. Auxiliary fire services in large manufacturing and mercantile establishments are described in the report. These auxiliary services are under the general direction of the chief of the local fire department. For the 6,000,000 inhabitants of London, only 1,200 men were employed, in the year 1904, for fire protection purposes, not including those in the different mercantile establishments. The total cost of

maintenance of this fire department was about $1,200,000; of this, the general government contributed about $50,000, and insurance companies $175,000.

BUILDING REGULATIONS.—Another matter that impressed Mr. Thomson was the attention given in European cities to "the sanitary construction of their cities, as regards light and air and the location and ventilation of buildings." Mr. Thomson calls attention to the desirability of restricting the percentage of city blocks that can be built upon in Seattle, and states that it may be necessary in the future "to institute a wholesale condemning of alleys in the city, so as to provide reasonable width for air space at the rear of apartments and other dwellings."

COST OF REINFORCED CONCRETE ARCH BRIDGES.

By GEORGE P. CARVER.*

The writer has been recently engaged to estimate approximately the cost of a considerable number of reinforced-concrete arch bridges which are to be constructed in connection with the building of a high-speed interurban electric railway in Massachusetts. The line of this proposed road runs through several cities of considerable size, and it is intended to cross over all streets by reinforced-concrete arches. The spans necessary at each crossing vary considerably, but the general conditions affecting labor and materials are so nearly alike at most points on the line that the cost of any of the proposed arches depends entirely on its span. This does not apply to arches of very small span, as the centering in such cases is simple and can be erected at a considerably less cost, per cubic yard of concrete in arch, than in a long span. The proportion of cost to span holds in arches from 30 to 100 ft. span.

Assuming the conditions to be similar in all cases, the writer designed three arches, of 50, 75 and 100 ft. span, respectively, with 28 ft. total width in each case to allow for two railway tracks. The quantities from each design were separately computed, with unit prices which represent the cost of labor and material for this class of work under the conditions which will probably prevail if these bridges are constructed within one year. To the total cost so obtained, 15% has been added to cover incidental expenses and 10% for contractor's profit.

With these results for these three spans a curve has been plotted (Fig. 1), by inspection of which the cost can be obtained from the known span. Fig. 2 shows the details and design for the 100-ft. span arch which crosses a wide street carrying a double-track electric car line.

Tables are also herewith given which show in detail the computed quantities in each arch, the unit prices and the total cost.

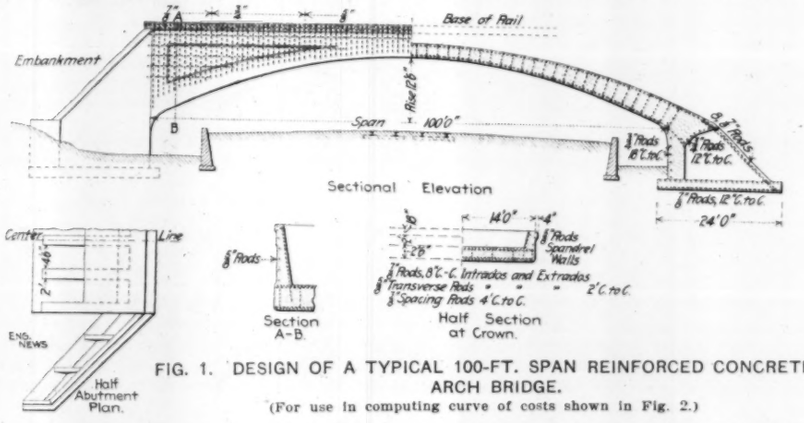


FIG. 1. DESIGN OF A TYPICAL 100-FT. SPAN REINFORCED CONCRETE ARCH BRIDGE.

(For use in computing curve of costs shown in Fig. 2.)

*Consulting Engineer, Exchange Building, 53 State St., Boston, Mass.

ITEMIZED COST OF REINFORCED CONCRETE ARCHES.

Span, 50 ft.; Width, 28 ft.	
Steel, 27,700 lbs. at 2½ cts.	$692.50
Steel placing, 27,700 lbs. at 1 ct.	277.00
Formwork at $1 per cu. yd	370.00
Cement, 481 bbls., at $2	962.00
Sand, 185 cu. yds. at $1	185.00
Stone, 370 cu. yds., at $2	740.00
Mixing and placing 370 cu. yds. at $1.50	555.00
	$3,781.50
Incidentals add 15%	567.22
	$4,348.72
Profit add 10%	434.87
	$4,783.59
Span, 75 ft.; Width, 28 ft.	
Steel, 38,800 lbs. at 2½ cts	$970.00
Placing steel, 38,800 lbs. at 1 ct.	388.00
Formwork at $1 per cu. yd	740.00
Cement, 962 bbls. at $2	1,924.00
Sand, 370 cu. yds. at $1	370.00
Stone, 740 cu. yds. at $2	1,480.00
Mixing and placing 740 cu. yds. at $1.50	1,110.00
	$6,982.00
Incidentals add 15%	1,047.30
	$8,029.30
Profit add 10%	802.93
	$8,832.23
Span, 100 ft.; Width, 28 ft.	
Steel, 55,650 lbs. at 2½ cts.	$1,391.25
Placing steel, 55,650 lbs., at 1 ct.	556.50
Formwork, at $1 per cu. yd	1,008.00
Cement, 1,310 bbls. at $2	2,620.00
Sand, 504 cu. yds. at $1	504.00
Stone, 1,008 cu. yds. at $2	2,016.00
Mixing and placing 1,008 cu. yds. at $1.50	1,512.00
	$9,607.75
Incidentals add 15%	1,441.16
	$11,048.91
Profit add 10%	1,104.89
	$12,153.80

LIGHT LOCOMOTIVES of a type adapted for steam road-roller construction are being introduced in England for contractors' use and industrial railways. They are built by Aveling & Porter, of Rochester, England, builders of steam rollers and traction engines. The cylinders (simple or compound) are mounted on the boiler, and drive a crank shaft with a train of gearing to the driving wheels. The engines are mounted on four wheels, and are designed to ascend grades as steep as 5% and to pass curves of 35 ft. radius.

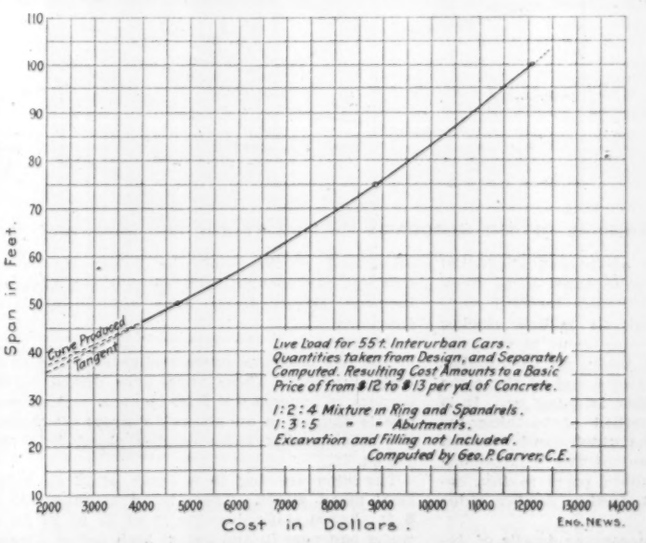

Span in Feet.
Cost in Dollars.
Curve Produced Tangent
Live Load for 55 t. Interurban Cars.
Quantities taken from Design, and Separately Computed. Resulting Cost Amounts to a Basic Price of from $12 to $13 per yd. of Concrete.
1:2:4 Mixture in Ring and Spandrels.
1:3:5 " " Abutments.
Excavation and Filling not Included.
Computed by Geo. P. Carver, C.E.
ENG. NEWS.

FIG. 2. CURVE SHOWING COSTS OF REINFORCED CONCRETE ARCH BRIDGES.

THE LAND AND WATER TERMINAL OF THE SEABOARD AIR LINE RAILWAY AT SAVANNAH, GA.

The new terminal which the Seaboard Air Line Railway has just completed at Savannah, Ga., was quite fully described by Mr. W. D. Faucette, Assistant to Chief Engineer of the railway at a recent meeting of the "Associated Engineer's and Constructor's Society, of Tidewater, Va." Much time and labor has been given the design of this terminal and some of its features are of considerable novelty and worthy of study. The following description is abstracted from Mr. Faucette's paper.

The design of a railway terminal on a waterfront where both land and water transportation have to be taken into account presents many problems not at all like those found in the terminal for either land or water alone. There are some points in the basis of such a design which must always be considered. There must be the best utilization made of the site at hand by arranging the track facilities so that (1) both waterfront and storage can be economically served, and (2) the movement of cars can be efficiently carried on. In carrying out these details system should be used, the carrying and jamming of tracks and buildings should be avoided, buildings should be arranged so that they can be served by tracks without curves, and tracks should be parallel to waterfronts as far as is possible.

In addition, the utilization of present site is only one part of the best design; care must be taken to provide conditions and place for any future revision or extension. This latter has not been sufficiently looked after in past operations, in fact many thousands of dollars are now being expended in this country in the revision of railway terminals where a very good design was made for the situations at the time of construction but where the growth of business has necessitated extensions for which there was no allowance nor provision in the old scheme.

As an example of a land and water terminal which is thought to have followed the principles laid down above, the Seaboard Air Line terminal at Savannah, Ga., is worthy of notice. This is the terminal of the railway on Hutchinson Island, in the Savannah River, directly opposite the city of Savannah, and is the transfer point of all southern freight to and from a large coastwise and foreign shipping. The general layout of the terminal is well shown in the accompanying map. The trains enter on a ladder of three tracks which switch into five parallel tracks on the four parallel piers. These tracks are laid on open piers about 40 or 50 ft. back of the face of the dock, enabling quick and rapid service in the placing of material to any berth in the slips.

It will be noticed that on some of the piers there are no warehouses, but the tracks run along near the edge of the dock. This is satisfactory in the handling of lumber and open shipments requiring no protection. However, for material on storage required to be held for some time, such articles as sugar, salt, pyrites, ores and likewise, storage must be had, and in this case the storage warehouses are built nearer the slip fronts and the tracks laid back of these warehouses. This enables direct storage, under cover, from cars when ships are not available for immediate sailing. There has been some championship of the method of putting tracks into the warehouse and storing on either side. In the case of this terminal, this idea has been

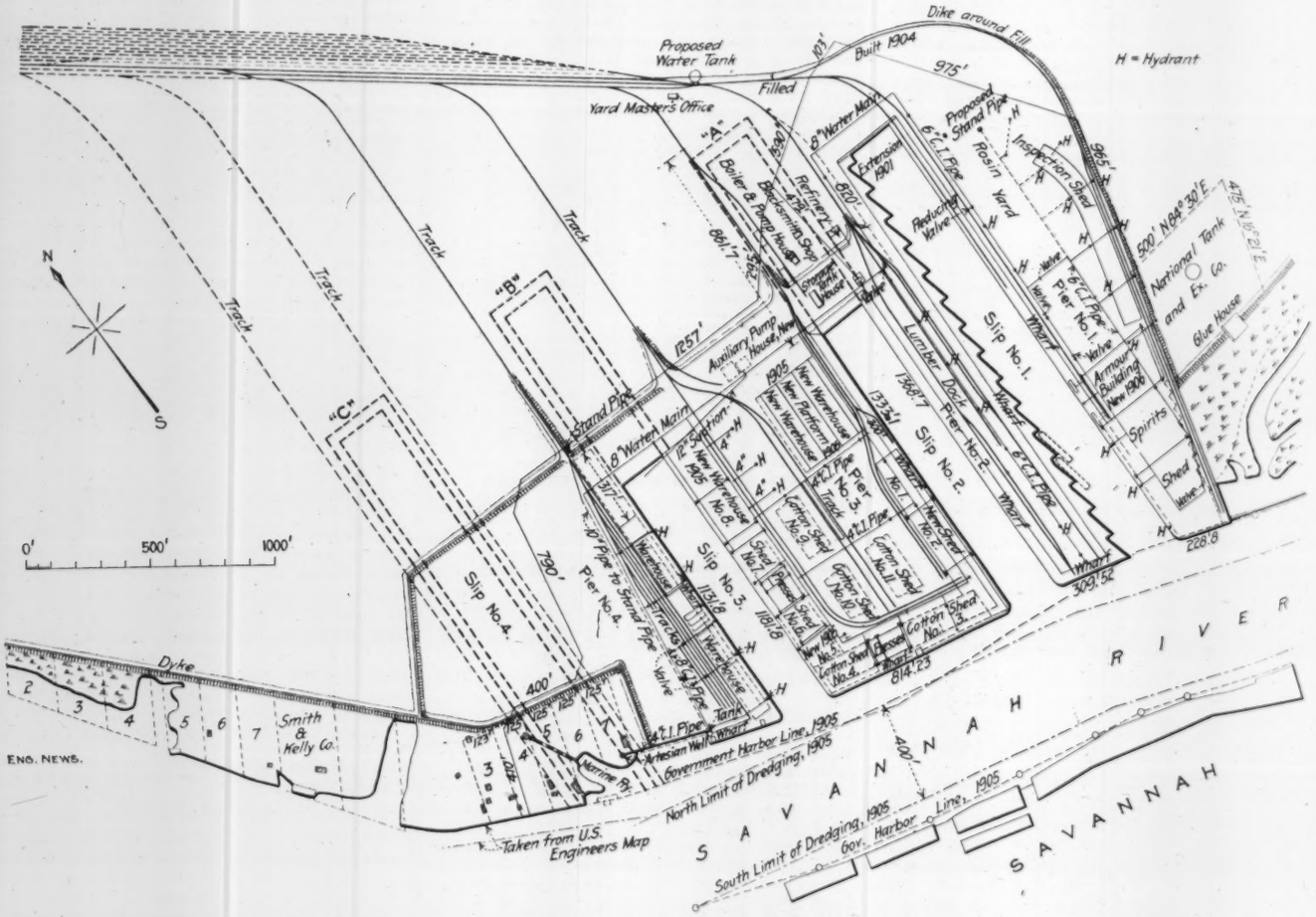
abandoned and the tracks wherein storage warehouses are to be served are in every instance laid in the rear. The argument in favor of this is the saving of storage space by the width of the clearance, the reduction of hazard on the part of train employees, and the reduction of fire hazard on the part of the engine entering these buildings.

Pier No. 2 is remarkable in many ways. It is one of the longest, if not the longest, pier slips in existence, measuring 2,000 ft. from the harbor line to its extreme outer end. As in all of the slips the width clear between dock lines is here 200 ft. It is thought by Mr. Faucette that this 2,000-ft. length is the most economical for a 200-ft. width, and that it is not desirable to build slips in any terminal longer than this on account of the congestion in placing and removing boats in greater lengths. Another feature is the saw-tooth arrangement of one side of Pier No. 2. one which is not always looked after in designing yards.

The question of the availability of the yard for extension has been most freely entered into. The heavy dotted lines on the map show such extensions as can be entered into on this terminal and provide adequate facilities for an enormous increase in business without the rearrangement of any tracks but simply by direct continuous extension along the lines indicated. Savannah is a city of practically 80,000 people. The actual facing waterfronts occupied by this terminal is about 2,400 ft.; with the slips cut as shown, there is a water dockage front of 8,700 ft., or for 24 ships with 300 ft. to each. With the increase in slip No. 2. slip No. 3 and the construction of slip No. 4, which increase the length of the river front by 800 ft., or 10%, the increase in dockage space would be 80% over what is now had, or room for 53 vessels. At the

The height of the surface of the docks above local low water is 13 ft., while the original elevation of the unimproved island was about 4 ft., necessitating a fill and retention to the height of 9 ft. immediately surrounding these improvements and practically all the area enclosed in tracks on the drawing shown has been raised to this elevation, while all surrounding land is still low. Much of this fill was made by pumping from slip No. 2, which had been allowed to become a dumping ground for material taken from the river by the government in its dredging operations.

The subject of fire protection has been made a special study in this design. A full line of water-mains cover the entire area, and in addition fire-walls extending through the roofs of the various buildings have been built in many places, as indicated on the drawing. These walls have bases extending to within 4 ft. of low water where they



FREIGHT TERMINAL OF THE SEABOARD AIR LINE RY. ON THE SAVANNAH RIVER WATER FRONT AT SAVANNAH, GA.

There are 15 of these saw-teeth each about 130 ft. long and so arranged on an angle as to allow boats to lie in parallel with their forward port-hole nose directly against an incline sloping front. This method of arrangement is provided especially for the lumber trade, as the lumber can be loaded into this forward end at the same time that other deck loading is going on. It is to be noted that this method of toothing increases the number of boats which can be docked along a pier, and on account of this it is becoming quite common in southern ports to-day, especially in coastwise and foreign lumber shipments.

The second part of the necessary details of designs as noted above, viz., that movements of cars can be efficiently carried on, is looked after here. Each pier is well served, so that no interference of trains occurs. The ladder is amply large enough to handle all traffic the piers can bear. No grade crossing of tracks is found in the entire layout. This last item is one of great importance in an efficient and rapid service, but other end of the yard, the ladder tracks are now set far enough back so that the proposed increase shown there does not throttle the entrance.

On account of the extreme low bearing value of the soil here the entire foundations had to be built on piles. These piles were driven in the corners of squares 6 × 7 ft. in area, and as each pile is figured on an allowable stress of 20 tons, the safe bearing value reaches about 1,000 lbs. per sq. ft.

The slips are dug to a depth of 22 ft. below local mean water. There is an average tide of 6 ft., hence ships drawing from 25 to 27 ft. of water can pass in and out at high water. Deeper draft vessels than the local water allowance are loaded here as in all other places, the nature of the bottom of most of the foreign tramps allowing them to rest easy at low tide, solely on the mud, and floating well at high water. The slips are maintained by the company, and dredging is a necessity about every three years due to silting and filling.

rest on a pile and grill-work foundation. Throughout the work the specifications and inspection of the National Board of Underwriters have been adhered to as far as possible, so that as a result the insurance rates are extremely low for this class of construction.

In the opinion of Mr. Faucette there are but two vital changes which might be made in the design of the terminal if it were to be built again. The obtuse angle (about 104°) between the river axis and the slips might be increased by about 5° without any hurt to the terminal but with a benefit to the traffic, for the reason that incoming steamers of the ocean-going type are compelled to turn almost at right angles to dock in the slips, and during the progress of turning almost totally block the river channel. With a stiff east wind and heavy tide, this docking is troublesome, and a greater angle should help the situation. The lumber dock (No. 2) might also be made more available for storage purposes by widening it about 100 ft. With these two exceptions it is thought the terminal ad-

mirably serves the purpose for which it was planned.

For the general idea of the yard credit is due to Mr. W. W. Mackall, of Savannah, and for its completion to Mr. R. A. Blanford, also of Savannah. The Chief Engineer of the Seaboard Air Line Ry. is Mr. W. L. Seddon, and he and his assistant, Mr. Faucette, the author of the paper from which this article is taken, were in charge for the railway company.

EXAMINATION QUESTIONS FOR THE POSITION OF ASSISTANT ENGINEER, BOARD OF WATER SUPPLY, CITY OF NEW YORK.

By CANDIDATE.

It was reported that 460 persons filed applications with the Municipal Civil Service Commission for the examination (July 31, 1907) named in the title to this article. With this number of candidates to select from it was expected that the Commission would set a pretty stiff examination paper. Though it was not really a "snap," the writer does not believe that any candidate, ambitious for an upright and conscientious engineering career, can justly criticize the Commission for the questions set. A recent graduate from a reputable technical school, with some engineering experience, who has done thoroughly conscientious work throughout his entire college course, and who does not pass this examination, had better for his own good, and that of the profession generally, let someone else take his place.

The examination was divided as follows:

(1) An "experience" paper made out in the handwriting of the candidate, and sworn to by him, was handed in at the opening of the examination. This paper counted 20 possible points.

(2) A "technical" paper begun as soon after ten o'clock as possible, the hour set for the examination, consisted of 15 questions, and had to be completed by half-past two o'clock. This paper counted 50 points.

(3) A "mathematics" paper consisting of five questions, and counting 15 points.

(4) A "report" of not less than two nor more than three pages, counting 15 points.

To pass the examination, candidates were required to get an average of 75% on the technical paper, not less than 20% on any paper, and an average of 70% on all.

Candidates not being allowed to take a copy of the examination questions from the room, and the writer being too much occupied with something else besides memorizing a list of questions, he will not vouch for the order of the questions, or phraseology, or the intentions of the examiners; but in substance 14 of the 15 questions in the technical paper were as follows:

(1) Give briefly the engineering work necessary before deciding on the location of a reservoir site.

(2) Describe the method of Stadia Surveying and explain its advantages and disadvantages over other methods.

(3) What is meant by "cross-sectioning" as applied to leveling?

(4) If the proposed site of a reservoir takes in very valuable land tell how its area may be accurately determined.

(5) Describe the planimeter and tell how it is used in finding areas.

(6) Outline specifications for piles and pile-driving.

(7) What is meant by "impervious," "reinforced" and "rubble" when applied as adjectives to concrete; "Ashlar" and "Cyclopean" as applied to masonry?

(8) What is the best way of draining the roadbed of a railroad or a highway in a cut?

(9) Explain how points are given for the excavation of a tunnel with reference to alinement and elevation.

(10) Name the causes or omissions that are unfavorable to good work in concrete construction.

(11) Imagine a concrete pier to be constructed under water. Give methods to be followed in order to procure efficient construction (not repeating anything given in (10) above.

(12) Outline briefly the design and construction of a heavy masonry retaining wall.

(13) Describe the construction of a macadam roadway.

(14) Make sketches of the design (giving dimensions of the timbers) of a trestle for carrying a railroad of standard gage across an embankment 50 ft. high.

The five questions in "mathematics" were about as follows:

(1) Extract the Square Root of 119339.847936.

(2) Find the number of Board Feet in the following Bill of lumber:

64 Pieces 16″ × 4″ 18′ 0″.
72 Pieces 12″ × 6″ 20′ 6″.
30 Pieces 10″ × 3″ 24′ 3″.
366 lineal feet of Plank 10″ × 2″.

(3) Find the area of a circular piece of macadam roadway, 30 ft. wide, the inner side of which is 540 ft. long, measured on an arc of 600-ft. radius.

(4) If a retaining wall, 2 ft. wide at the top and 26 ft. wide at the bottom, has a batter of 1 in. per ft. on the face and 3 ins. per ft. on the back, find its height and its contents in yards per lineal foot.

(5) An embankment of triangular cross-section is 100 ft. long and has the following end dimensions: At one end the base is 56 ft., and the height is 22 ft.; at the other end the base is 47 ft. and the height is 31 ft. Find its volume by the prismoidal formula.

For the "report," which was to be in the form of a letter from John Doe to his superior, the candidate had a choice from several subjects, some of which were similar to the following:

(1) Survey for the location of a dam.

(2) A proposed canal compared with a tunnel one-fourth its length.

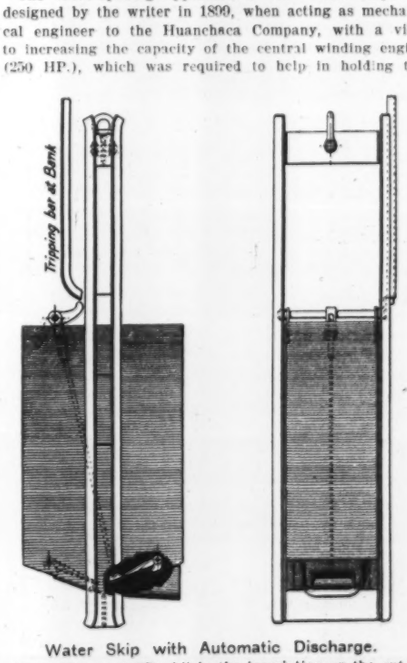
(3) A complete drainage survey.

(4) The construction of a large masonry dam or a heavy retaining wall.

A WATER SKIP WITH AN AUTOMATIC DISCHARGE.*

By W. R. FRANCIS,† Stud. Inst. M. M.

The valve-opening apparatus of this water skip was designed by the writer in 1899, when acting as mechanical engineer to the Huanchaca Company, with a view to increasing the capacity of the central winding engine (250 HP.), which was required to help in holding the water in the flooded 326 gallery (326 m. below the surface).



Water Skip with Automatic Discharge.

Note: The word "Bank" in the inscription on the cut is the English term for the mouth of the shaft.

Tanks similar to that shown, but smaller, and fitted with a hand lever and cord, had been in use for some time, but were found to be insufficient as they wasted too much time at the end of each trip. The new apparatus proved an entire success. The tanks, being larger, carried a larger load, and the time gained between trips made it possible to haul about 760 tons more water per 24 hours on this account alone.

The original skips are still running, and all the shafts are fitted in exactly the same way. The main advantages claimed are that the valves are large, allowing of rapid filling; the tripping bar at the mouth of the shaft allows of the skip being raised right up to the poppet-heads while following down the water level with the other skip. The discharge takes place all the time after reaching the surface, into a tower having a louvred front like a venetian blind to prevent the water from returning to the shaft. No pause is required, the engine being simply reversed.

*From Bulletin No. 10 of the Institution of Mining and Metallurgy, London, Jan. 10, 1907.

†Gerente, La Cia Estanifera de Llallagua, Bolivia, South America.

THE RAILWAYS OF CAPE COLONY had an aggregate length of 3,191 miles at the end of 1906, according to the annual report of Mr. T. S. McEwen, General Manager. The traffic for the year, with the total receipts and expenditures, were all less than for the year 1905. The railways are owned and operated by the government, and in view of the present depression it is recommended that no railway be constructed where there is a possibility of ox-wagon competition, unless the government passes a proposed law taxing wagon transport when it competes with railway. A 24-in. gage line from Port Elizabeth to Avontuur, 177 miles, has been opened, with two short branches. The schools for children of railway employees now number 47, with 2,775 children in attendance.

The policy of building the car bodies at the railway shops has been adopted, and only the metal underframes are now imported. The staff comprises 10,576 Europeans and 7,075 colored employees. It is proposed to put the control of the railways in the hands of a special railway commission in order to eliminate the political influences and interferences which have been a source of trouble for some years.

Only two train accidents occurred during the year, one caused by a washout just before a night trackwalker reached the spot, and the other by the fall of a rock upon the track just after a trackwalker had passed. The total number of deaths on the railways was reduced from 57 in 1905 to 39 in 1906, largely owing to the enforcement of regulations against trespassing.

Double tracking and the extension of block signals are being proceeded with on busy main lines and suburban lines in order to facilitate traffic and reduce the delays due to passing trains. Grade reduction work is now in progress. Special attention is given to the loading of cars and trains, with the result that on the main line the trains averaged 97.2% of their full loads. A new design of engine truck with swing bolster and spring control, designed by E. W. Sim, one of the division superintendents of motive power, has been introduced, to reduce the flange wear on lines having sharp curves; but it is pointed out that this is not likely to reduce the rail wear, as 35-ton freight cars with bodies resting heavily on the side bearings are severe "rail cutters." In the locomotive department, also, solid-drawn steel boiler tubes are being substituted for brass tubes on all the lines. The equipment includes 653 locomotives of 3 ft. 6 ins. gage, 14 of 2 ft. gage, one steam motor car and two gasoline motor cars. The operating expenses of all lines were 79% of the gross earnings, as against 76% in 1905 and 90% in 1904. Mr. H. Beatty is Chief Locomotive Superintendent, and Mr. Alan Grant-Dalton is Engineer in Chief.

MUNICIPAL BATHS AND WASH-HOUSES have recently been opened by Woolwich Borough (London). The buildings and equipment cost some $200,000. Two swimming pools are provided, 40 × 100 ft. and 32 × 80 ft., respectively; 65 slipper baths, 9 spray or Lassar baths, and 1 Russian vapor bath. The public wash-house is provided with 30 wash stalls and is fully equipped with modern laundry apparatus. The water supply is drawn from an artesian well, sunk 400 ft. below the floor level. The water is raised from the well by means of an air lift, with an hourly capacity of 24,000 U. S. gals. The water being from the chalk, a softening plant has been provided; this plant has a capacity of 6,000 U. S. gals. per hour, and beneath it is a water storage tank of cast-iron plates, with a capacity of about 17,000 U. S. gals. A filtration and aeration plant has been provided for purifying the water from the swimming pools so as to lessen the necessary frequency of renewing the water. The whole establishment was designed by Mr. Frank Sumner, M. Inst. C. E., until recently Borough Engineer of Woolwich, and now Engineer to the City of London. The plans were carried out by Mr. J. Rush Dixon, M. Inst. C. E., who succeeded Mr. Sumner. In accordance with common practice in Great Britain, the bath-house forms a part of a group of public buildings, which in this case includes a public hall and free library. The baths are described and illustrated in detail in the London "Surveyor" for June 28, 1907.

A REPORT CARD SYSTEM FOR DREDGING WORK.

In our issue of June 13, in an article descriptive of the Bush Terminal R. R. Co.'s dredge "Independent," mention was made of a report card system in use on that dredge and possessing features of some novelty. The system was devised by Mr. William H. Arnold, M. Am. Soc. C. E., who was prior to June 1 Chief Engineer of that company. We are indebted to Mr. J. A. Warner, General Superintendent of the company, for samples and data from which the description below was prepared.

The complete report cards are made up in three sections, perforations allowing the sections to be detached for use. Figs. 1 and 2 show both sides of a complete card. All of the information required concerning the loading of a scow is printed on the card, and such information as applies to the loading of any one scow is indicated by a punch marked opposite such information.

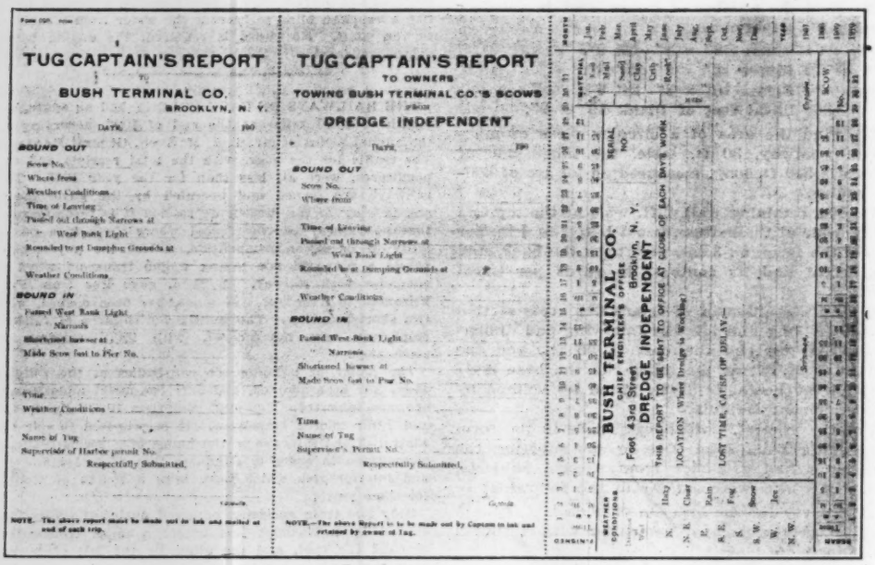


FIG. 1. REPORT CARD SYSTEM, DREDGE "INDEPENDENT;" FRONT OF COMPLETE CARD.

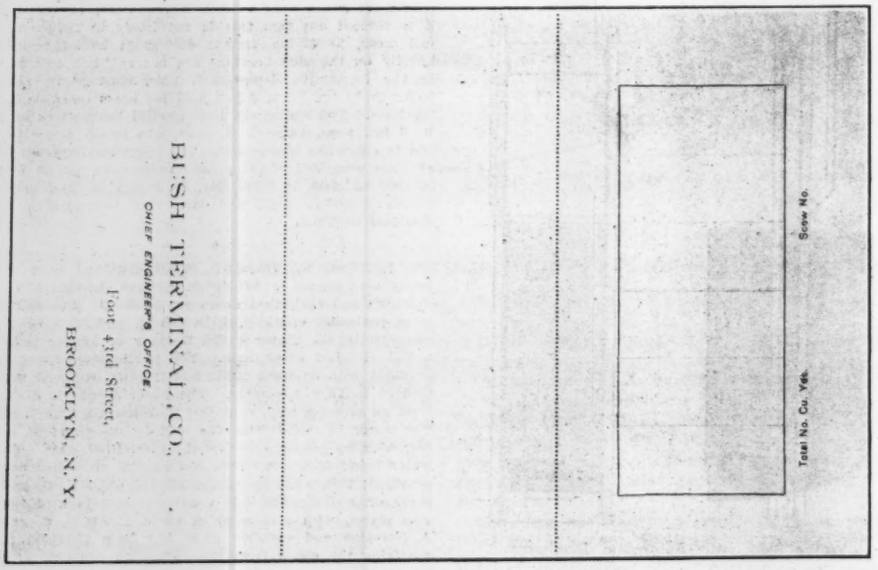


FIG. 2. REPORT CARD SYSTEM, DREDGE 'INDEPENDENT;" BACK OF COMPLETE CARD.

Provision is made to show the date, hour and minute at which the loading of the scow was begun and completed. The weather conditions, the kind of material handled, the location where the dredge worked, and any delays that may have occurred, are also provided for.

The amount of material loaded in the scow is indicated by a percentage system. In the sample card which has been filled out—see Fig. 3—the loading was 60% sand, 35% crib and 5% rock. The percentage, of course, is based on the carrying capacity of the scow, which in the case of the Bush Terminal R. R. Co. is 800 cu. yds.; hence, as indicated, 60% of the 800 cu. yds. was sand.

On the back of this portion of the card is a diagram representing the six pockets of the scow; this diagram is shown in Fig. 2. When this portion of the card is filled out, notations are made in each of the six spaces in this diagram, showing how many of the pockets are full and how many partly full. Where the pockets are not filled, the shortage is indicated by the number of feet and tenths of feet that each pocket is short-filled; i. e., if five of the pockets were full and the sixth 0.5-ft. short-filled, the spaces representing the full pockets would contain the word "Full," and in the short-filled pocket would be made simply the notation "0.5." In the case of an 800-cu. ft. scow, then, that would indicate that pocket No. 6 was filled to within 6 ins. of the top of the coaming, and the total yardage for that scow would be 792.5.

Fig. 3 shows the portion of the card on which the punch records are made, as filled out. On this portion of the card, the serial number indicates the consecutive number of scows loaded; for example, the serial number 250, shown in Fig. 3, indicates that the scow covered by that report is the 250th scow loaded since the dredge began operation.

The other two portions of the card, as shown in Fig. 1, are filled out by the captain of the tug which tows the scows to sea. They are given the same serial number as that given to the report of scows loaded. The addressed section is mailed to the Bush Terminal Co. and the unaddressed section sent to the owners of the tug towing the scow, for their information in rendering bills for towage.

The serial number of each scow is shown on the towing company's bill, thus enabling the towing company and the Bush Terminal Co. to agree without dispute upon the amount of any towing bill.

RELATIONS OF THE ENGINEERING SCHOOLS TO POLYTECHNIC INDUSTRIAL EDUCATION.

Retiring President Dugald C. Jackson,* of the Society for the Promotion of Engineering Education, took the foregoing title for his presidential address at the fifteenth annual convention of the Society at Cleveland, on July 2, 1907.

In treating his subject, President Jackson brought out an educational need which has been given by far too little attention in this country: the establishment and development of schools for master craftsmen or industrial foremen.

Apropos of engineering education at state institutions, Prof. Jackson said, in part:

The United States Congress of recent years has added continuing appropriations of money for the same purposes (education in agriculture and the mechanic arts), but more particularly with the design of supporting agricultural research. These appropriations have been used with wisdom and with great advantage to the nation and its people; but, as far as mechanic arts are concerned, the term has been construed liberally and the work of the colleges using these appropriations has been largely in the grade of professional engineering work, or trending in that direction. The demand for university-trained engineers has been marvelous, and the land-grant appropriations have been insufficient to support more than one educational effort in this line; in many states they have been insufficient to support even one fully, so that it has been excusable in the past for the state colleges and universities to limit their activities. The diversion of fine private bequests, from their apparently intended use for the foundation of trades and foremen's schools to the support of attempted professional engineering schools alongside of enginering schools already in existence, seems to me not so excusable.

In agriculture, the situation has been different. The individual farmer, as a rule, is unable to carry on extended and expensive experiments for the benefit of himself and his fellows, and the agricultural schools have turned their attentions toward helping the individual farmers or dairymen by teaching them how best to carry on their trades. Some of our best schools of agriculture are what, in industrial lines, would be called foremen's schools; that is, they teach of the particular craft involved and the way in which the craftsmanship may be most advantageously invoked and applied by a master craftsman in every-day employment. These agricultural schools also support courses of instruction in scientific agriculture which are of university grade, and they maintain extensive and well-manned departments of research which have returned uncounted advantages for the appropriations expended.

The agricultural schools have thus undertaken to cover a triple field: The field of the master craftsman, the field of the scientific or professional agriculturalist, and the field of agricultural research. In the main they are occupying each of the fields well. This is in great contrast to the situation in the direction of industrial education, in which schools for master craftsmen—foremen's schools—are so few as to be almost unknown.

The engineering schools, like their friendly rivals, the agricultural schools, have before them a field which may be divided into three parts, two being semi-professional or completely professional, and the third vocational and subordinate to the others. The engineering schools have only occupied one effectively, though a few are now growing towards an occupation of the second.

These three parts to which I refer are the divisions of the educational scheme of the nation, in which fall: (a) engineering research and the advanced professional instruction which is being given here and there to a few graduate students; (b) the engineering courses of study as they are now ordinarily planned; and (c) the instruction of artisans and especially instruction adequate to

*Professor of Electrical Engineering at the Massachusetts Institute of Technology, Boston, Mass.

the needs of industrial foremen or sub-superintendents—i. e., master craftsmen.

The second of these educational divisions, in the order here named, it seems to me the engineering schools are occupying very well; but even here there is a lack of effectiveness which seems due to lack of correlation between the schools, and lack of study of pedagogic history by those persons responsible for the direction of the schools. Reasonable independence and individuality in methods of teaching are due to the individual men who are experienced and worthy in each school, and the individuality of the several schools must not and cannot be infringed; but unhappily, in the past, there have been contrasts of pedagogic views and professional ideals that cannot be justified, for in these things (matters of judgment though they be) truth can lie only in one direction, however diverse may be the paths over which it may be approached. In harmonizing these differences, pointing out the better paths to follow, and bringing the professional work of the several schools into correlation with professional practice, and especially in advancing the interests of engineering research and advanced professional studies which go to the solution of those numerous great problems of engineering which can best be solved by men independent of commercial industrial control but working in full harmony with the best engineers and manufacturers of the day, this society ought to have a large influence.

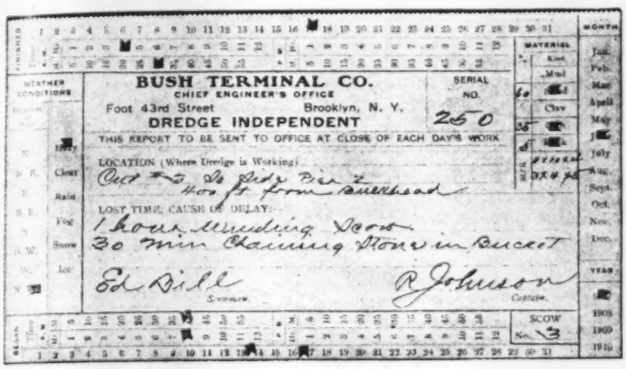


FIG. 3. REPORT CARD SYSTEM, DREDGE "INDEPENDENT;" LOADING REPORT PUNCHED AND FILLED OUT.

In the report of the first Industrial Commission of Massachusetts (1906) it is pointed out that no less than 25,000 boys and girls between the ages of 14 and 16 years were then engaged in various kinds of juvenile employment in that state, all without any adequate trade education.

It is for training such as these to a plane of skilled labor and secondary authority that Prof. Jackson has made his plea. The existing secondary industrial schools of the country, he says, are absolutely inadequate in numbers or scope to meet this problem; and "schools suitably planned for the appropriate education and improvement of foremen are almost unknown" in the United States.

In pursuing this point, he says further:

I lay this latter fact at the door of the engineering schools, and hold that the members of the faculties are not guiltless unless they make adequate efforts to get filled this need in education for master craftsmanship in the industries, which comes within the purview of their influence and direction.

The governing boards of the engineering schools must divide the guilt with the faculties, if they continue their common failure to provide sufficient teaching force in the engineering departments, thus putting any effort which reaches beyond the routine of the department curriculum and touches the larger interests of the industrial body beyond the physical endurance of the individual members of the faculties.

Governing bodies have also been at fault heretofore in a too close adherence to a standard for engineering teachers in which mere ability to impart information in the class room, without consideration of any breadth of ambition, has held too predominant a place in the selection of men, and breadth of view in industrial affairs accompanied by clearness of judgment has had too small a place. I do not undervalue the technical ability to impart information in the class room, and assent that this should be properly given much weight in selecting men for the engineering faculties; but this ability, however largely developed and however fully accompanied by engineering skill, is far from sufficient to make an adequate member of an engineering faculty.

The acts of many governing bodies heretofore are in some degree excusable, in consideration of the breathless growth of engineering schools which has seemed to make impracticable any pause for thought or consideration of needs beyond those of the day's pressing want of active teachers and suitable appliances to give strength to their teaching. It seems to me less excusable that so large a proportion of the leading men in the engineering schools should neglect on their own part a due consideration and study of pedagogic history, and the development of the lines of philosophy and sound pedagogic thought, which lead inevitably to broader sympathies and more comprehensive professional views. An engineer who has cultivated a correct professional spirit ought promptly to recognize and appreciate fully the importance of careful study of professional precedents of the best type; and if the engineer is also a teacher he seems to be under obligation to take a comprehensive view of both sides of his vocation—the side of engineering and the side of education.

I believe that such views lead emphatically to the proposition that engineering schools are called upon to extend their influence so that they will continue their present work of education for the scientific engineer: advance the work of engineering research and advanced professional study; and also foster the establishment, maintenance and development of polytechnic schools for master craftsmen.

As instances of a start in the direction of such polytechnic schools, fostered by the faculties of engineering schools, I will point to the Summer School for Artisans at the University of Wisconsin, and the Lowell Institute School for Industrial Foremen at the Massachusetts Institute of Technology. Certain courses at the Pratt Institute of Technology are instances of work successfully done in the same direction in an independent school, but even there the work is directed by men who have had experience in the faculties of engineering schools. Such schools, supported by endowments or by the State, could wisely be founded in each large industrial center; but in each instance the school government needs the combined interest, activity and support of the better manufacturers, and of suitable members of the faculty of a great engineering school. It must always be borne in mind that these schools should equally assist the craftsmen and the industries employing them, and thereby improve the fitness and promote the prosperity of the State.

REPORT ON THE DISPOSAL OF TRADE WASTES OF READING, PA.

The general subject of trade wastes has been reported upon many times by engineers, but rarely if ever have the trade wastes of a given city been taken up in such detail as in a report made on April 30, 1907, to the Board of Public Works of Reading, Pa., by Mr. Elmer H. Beard, City Engineer of Reading, and Messrs. Hering & Fuller, Consulting Engineers, of New York City. The report is the result of a communication to the Mayor of Reading from Dr. S. G. Dixon, State Health Commissioner of Pennsylvania, calling attention to the nuisance caused by trade wastes discharged into the Schuylkill River and canal at Reading.

Some of the wastes of industrial establishments in Reading are discharged into the sanitary sewers, but most of them reach the river or the canal. As a preliminary to the investigation, a list of all the industrial establishments in the city was made up from the city directory. Later this was supplemented by local inspections. A corrected list showed about 131 establishments requiring investigation. The more important of the plants were examined in person by Mr. George A. Johnson, Principal Assistant Engineer to Hering & Fuller. Samples of wastes from typical works were collected for examination at 15-minute intervals throughout the whole day. Portions of the samples were analyzed in triplicate. Analyses were made in the city laboratory under the direction of Mr. Johnson, by Mr. Howard Gerber.

The trade wastes of the city were divided into three classes: (1) Those not requiring withdrawal from the canal or river; (2) those requiring withdrawal, but which cannot be admitted to the sanitary sewers of the city; (3) those requiring withdrawal, but which may be admitted to the sewers. The only wastes (Class 2) that could not be admitted to the sewers were those from the gas-works of the city and the gas-holder of the Philadelphia & Reading R. R. The report states that these gas wastes should be treated on the grounds of the gas-works, by the parties directly interested.

Of 62 establishments whose trade wastes should not be allowed to enter the river or the canal but might be discharged into the city sewers about half are already connected. The remaining 31 works in this class, with the character and volume of their wastes, are listed in Table I.

The total quantity of the wastes from the works indicated in Table I is about 1,500,000 gals. per day for six days in the week, or approximately 10% of the water consumption and of the dry-weather sewage flow; or, again, about the equivalent of the average sewage flow from a population of 10,000. Coarse suspended matter in these trade wastes can be overlooked, generally speaking, except in the case of hat factories, the felt and fiber from which should be removed by screening or by settling basins.

Analyses of eight representative trade wastes are given in Table II.

The report holds that the analyses indicate that most of the suspended matter from these wastes would be deposited in the septic tanks rather than in the receiving wells at the pumping station. It might be necessary at times, however, to remove some of the coarse suspended matter in the paper-mill and tannery wastes before these wastes are discharged into the sewers. This the report indicates could be done by means of settling basins. The city should reserve to itself the right to require the construction of such basins before allowing the establishments to connect with the sewers.

The studies indicate that none of the trade wastes contains matter whose germicidal action would interfere with the normal operation of sewage disposal works.

The conclusions and recommendations of the report may be given in full, as follows:

After full consideration of the evidence upon the trade wastes proposition in order to eliminate present nuisances as required by the State Department of Health, we have

TABLE I.—CLASSIFIED LIST OF ESTABLISHMENTS THE WASTES FROM WHICH WILL BE TAKEN INTO THE CITY SANITARY SEWERS.

Establishment. No.	Classification.	Kind of waste.		Approx. volume in gals. daily.
1	Soap works	spent	lye liquor	140
7	Dye works	"	dyes, soda and wash water	165,000
1	Tannery	"	dyes, lime, etc., and wash water	30,000
2	Paper mills	"	lime, bleach and wash water	1,080,000
7	Hat factories	"	dyes and wash water	240,000
5	Electro-plating and galvanizing works	"	acid and plating liquors	25,000
2	Breweries	wash	water	25,000
6	Laundries	wash	water	6,000

TABLE II.—ANALYTICAL CHARACTER OF THE EIGHT REPRESENTATIVE TRADE WASTES.

Parts per 1,000,000.

Source.	Oxygen Consumed—Total 3-min. cold.	Oxygen Consumed—Total 5-min. boil.	Oxygen Consumed—Dissolved 3-min. cold.	Oxygen Consumed—Dissolved 5-min. boil.	Total organic nitrogen	Suspended Matter—Total.	Suspended Matter—Vol.	Suspended Matter—Fixed.	Iron. Dissolved Total.	Chlorine.
1 Tannery	64	441	20	112	130.7	2,954	1,465	1,489	5 tr	1,466
2 Paper mill	13	85	9	59	26.7	710	149	561	5 tr	216
3 Brewery	28	423	17	377	29.8	509	254	282	8 tr	166
4 Pickling liquor	..	...	..	...	....	504	320	184	....	....
5 Dye works	29	122	21	92	27.1	119	102	17	3 1	366
6 Wool hat factory	10	42	6	23	23.8	101	80	21	2 tr	125
7 Felt hat factory	18	57	12	43	20.5	77	54	23	4 4	233
8 Electro-plating works	9	24	8	20	19.1	97	48	49	22 19	566

come to the conclusions and recommendations which follow:

(1) The sanitary wastes from the industrial establishments within the sewerage districts shall be connected with the city sanitary sewers as soon as practicable.

(2) The 31 industrial establishments listed in the appendix, the trade wastes of which are summarized in Table I, and shown to aggregate about 1,500,000 gals. daily (roughly, 10% of the water supply), shall be connected with the city sanitary sewers as soon as practicable, subject to restrictions under supervision of the City Engineer, as follows:

(a) The volume of wastes shall be discharged at a sufficiently uniform rate to prevent overtaxing the capacity of the sewers.

(b) Felt, fiber and other objectionable coarse suspended matter shall be satisfactorily removed before entering the sewers by the use of a screen or settling basin, preferably the former.

(c) Other suspended matters which will deposit objectionably large amounts in the receiving wells at the pumping station shall be removed by sedimentation before entering the sewers.

(3) Whatever connections are necessary from the industrial establishments located within the present sewerage district, to the sewers as now designed, shall be built at once.

(4) Exhaust steam, cooling water and other liquids that are of a non-polluting nature leaving the industrial establishments, shall be allowed to continue to discharge into the river or canal. These, however, shall be freed from oil and any other objectionable matters to the satisfaction of the City Engineer.

(5) In view of the comparatively small quantity of trade wastes of widely varying quality from the individual establishments, the cost of their treatment can best be included in the general expenses of the Sewerage and Sewage Disposal Department.

RUN-OFF FROM POPULOUS DISTRICTS is to be studied by a committee appointed by the Sanitary Section of the Boston Society of Civil Engineers. The committee has issued a circular on the subject, in the coures of which it requests that run-off data be sent to it, and suggests that gaging stations for both rainfall and run-off be established in cities where such do not already exist. Mr. Irving T. Farnham, of West Newton, Mass., is chairman of the committee; Mr. Harrison P. Eddy, M. Am. Soc. C. E., 14 Beacon St., Boston, is secretary.

RAIL EXPANSION JOINTS ON THE THEBES BRIDGE.

On long-span steel railway bridges, expansion joints in the rails must be provided to accommodate the expansion and contraction movements of the spans. Such joints are usually of the lap type, the rail ends being lapped or scarfed so as to maintain a continuous rail while allowing for sufficient longitudinal motion in the adjacent rail. On the long bridge over the Mississippi River at Thebes, Ill. (described and illustrated in our issue of May 11, 1905), the rails do not lap, but have their ends 7 ins. apart, the wheels being carried across the gap by carrier or bridge rails laid against the outside of the track rails and bolted to one of these latter. This bridge was designed by Mr. Ralph Modjeski, M. Am. Soc. C. E., as Chief Engineer for the Southern Illinois & Missouri Bridge Co., and we are indebted to him for drawings of the rail expansion joints, from which the accompanying cuts have been prepared.

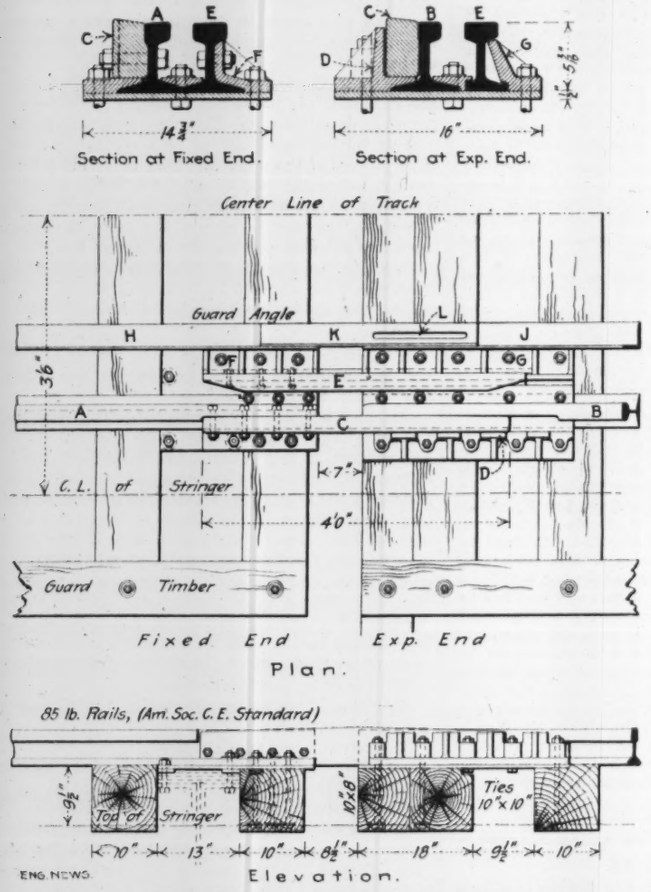


FIG. 1. RAIL EXPANSION JOINTS ON THE THEBES BRIDGE.

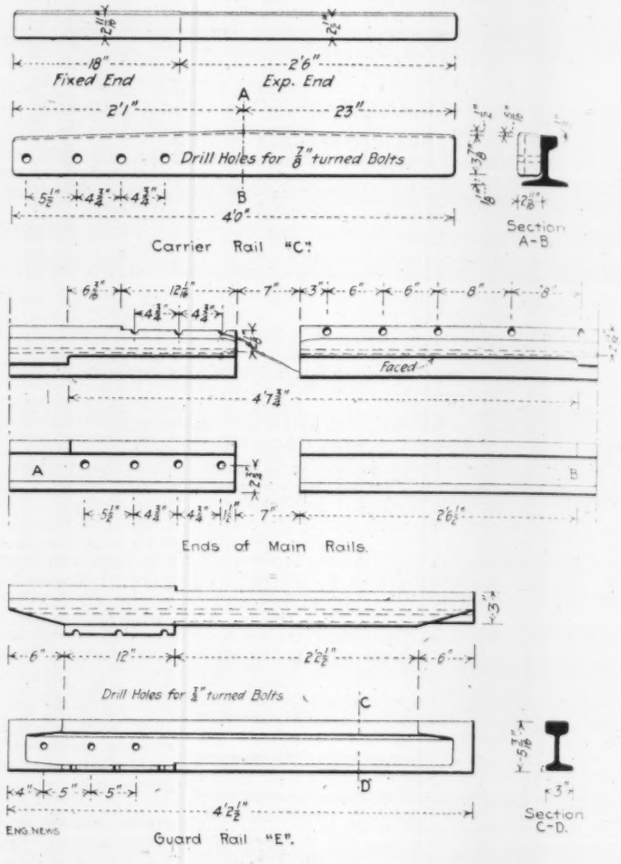


FIG. 2. DETAILS OF RAIL EXPANSION JOINT; THEBES BRIDGE.

The main rails A and B rest on ½-in. base plates, to which they are secured by cast steel angle bars bolted through the ties. The outside face of the head is planed away for a width of 29/32-in. for a length of 18¼ ins. on the fixed end and 2 ft. 6½ ins. on the expansion end. A rectangular bar of tool steel, C, about 4⅜ × 2½ ins. and 4 ft. long, is laid against the head and web of the rails, and is secured to the rail at the fixed end by four ⅞-in. turned bolts. The expansion end slides between the track rail B and the cast steel guide D. The head is planed on an incline each way from the center so as to make the wheels take a bearing easily and without shock, and the top is also beveled upward from the inside so as to ensure that the wheel treads will take a bearing. On the inner side of the main rails is a guard rail, E, 4 ft. 2½ ins. long, planed from an 85-lb. rail. At the fixed end this is bolted to a cast-steel splice, F, bolted through the base plate and ties. At the expansion end it slides against a cast steel brace plate, G, which fits under the head. This gives a flangeway of 1¾ ins., and holds the wheels over so that they take a full bearing on the carrier rail, C.

The track guard rails H and J are steel angles, 8 ins. from the gage side of the main rails, and these also are cut to leave a gap of 7 ins. An expansion piece, K, is laid upon the angles and bolted to the one at the fixed end. At the expansion end, the horizontal flange is slotted at L to receive a holding-down bolt which serves as a guide to keep the expansion guard rail K in position while allowing free longitudinal motion.

These expansion joints are placed at four points on the bridge, at the ends of the four anchor arms. As the bridge has two tracks there are 16 joints in all.

THREE-PHASE ELECTRIC TRACTION is to be applied to a stretch of main-line railway in Spain, part of the 145-mile line of the Northern Railway of Spain between Linares and Almeria. The line has a practically uniform gradient of 2¼%, which, under steam operation, proved increasingly objectionable, especially on account of the ore trains passing over the line. Electric operation, which enables concentration of motive-power to be practiced in high degree (by help of multiple-unit control), is therefore projected. According to information given us by Muralt & Co., Engineers, of New York City, an overhead contact system using 5,500 volts on the trolley is to be installed, with two overhead conductors (the return being through the rails). A single steam generating station will supply power to the trial line, without separate transmission lines and substations. Locomotives of 320-HP. rating each are to be used ordinarily two of these would be operated together, under multiple-unit control. When running down-grade, the locomotives return power to the line, as in other three-phase railways. The specified schedule involves hourly trains of 150 to 300 tons, running at mean speeds of 16 mi. per hr. either up or down grade. The trial section will be in service, it is thought, early in 1908, with equipment doubtless furnished by Ganz & Co., of Budapest, or by Brown, Boveri & Co., of Basel. It is believed that success here will lead to electric equipment of the entire line. Water powers suitable for operating the line have already been secured.

ENGINEERING NEWS

A Journal of Civil, Mechanical, Mining and Electrical Engineering

Published every Thursday by

THE ENGINEERING NEWS PUBLISHING CO.
220 BROADWAY, NEW YORK

BRANCH OFFICES
CHICAGO: 1636 Monadnock Block
WASHINGTON, D. C.: Home Life Building
ATLANTA: Candler Building
RUDOLF MOSSE, BERLIN AND HAMBURG, GERMANY

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Until very recent years the protection of buildings from lightning has been a neglected art and science. The study of the protection of electric transmission lines from these discharges has brought increased knowledge in the character of these phenomena, but the application of such knowledge has been confined, until recently, to the protection of electric circuits. The need of a more adequate protection than the Franklin rod affords has been long felt, especially for tall chimneys. In Germany, notable advance has been made by the development of protective schemes for dynamite factories. In this country, a substantial improvement has been wrought in the Franklin legacy.

As shown in Mr. Hopkins' paper in this issue, the new arrangement protects in two distinct ways. First, like the old Franklin rod, it helps to equalize the difference in potential between structure and cloud by a quiet discharge which gradually dissipates the dangerous accumulation of electrical energy. Secondly, as it forms a kind of "Maxwell cage," the dangerous discharges, the true lightning strokes, are kept outside the structure. The more complete the cage the more sure the protection will be from all strokes which cannot be prevented by the equalizing action of the apparatus.

In the hurry and excitement stirred up about the stock market depression, governmental interference, threats of prosecution of industrial criminals, and the like, it is well to remember that none of the technical conditions of the conduct of industry are affected in the slightest. The design, construction and service operation of every piece of industrial machinery bases on the same conditions to-day as it did two weeks ago or two months ago—except, let us say, for weather, advance of the season, and other such well-known factors. And involved in this fact is this further one: that while the mental or emotional state of the public, or of any part of the public, may undergo abrupt or precipitous changes, of large amounts, yet the underlying actual circumstances, with which industrial life deals, can vary only gradually and continuously. The technical and commercial problems of, say, the brick-making industry or the production of copper may be quite different six months from now, but it is mathematically certain that to-morrow, or next week, they will be measurably identical with those of to-day. There is no occasion for panics, or suddenly-varied impulse, in the technical and semi-technical part of business. The slow changes, on the other hand, must at all times be forecasted and provided against. We thoroughly believe that our industrial life contains enough ability and training for this purpose, and does in fact make such forecast and provision. Under these conditions, sound development and operation are at all times made certain.

The strike of the telegraph operators can serve the country in a very useful way by directing the attention of those in control of the telegraph companies more actively to the subject of machine telegraphs. The status of the telegraph art, as far as America is concerned, has often, and with good foundation, been described as one of complete stagnation; most recently, perhaps, at a meeting of the American Institute of Electrical Engineers, some months ago, when the subject of automatic multiplex telegraphs was discussed. It has been remarked that the entire electrical field, with the exception of the telegraph, has been developed in revolutionary manner in the last quarter century. The telephone, electric lighting, power production and utilization, traction, all have been transformed from a mere laboratory condition to a state of commanding importance in everyday life. Technically, in invention, design and commercial evolution, the progress has been correspondingly great. The telegraph, on the contrary, is much the same as it was thirty years ago, in methods and details as well as in rates and service. This, of course, is stagnation. Together with the much greater density of telegraph communication in Europe than in this country, it is often taken as basis for the inference that the managers of commercial telegraphy here have been unprogressive.

The machine telegraph is by many considered the chief improvement of which wire telegraphy is susceptible. It is able to increase the capacity of a single wire and to reduce the labor cost—the two great methods by which machinery cheapens and multiplies output. A variety of machine telegraphs has been constructed, most of them marvels of ingenuity, and equally marvels of complexity. This complexity has always been the bar in the way of their commercial use. It is doubtless true that no machine telegraph suitable for all commercial conditions has yet been offered. But there is no strong reason for thinking that such a device might not be developed, or that those which have been devised might not be perfected to such a degree as to permit advantageous application to limited parts of the telegraph network.

It happens that in the development of such a matter as an automatic telegraph instrument the isolated inventor is enormously handicapped. He is vastly less able to carry through the slow, expensive experimental work which necessarily precedes the construction of a perfected machine than is a large organization, so strong both technically and financially as a telegraph company. The risk of failure, also, is such as would discourage most men from even entering the field. Moreover, it is by no means certain that the man who invented and perfected a usable machine would find recognition for his device on the part of the telegraph companies, in the absence of all competition or regulation. Altogether, the situation dictates thorough study and exploration of the subject by the telegraph companies themselves, rather than by outsiders. If from the present strike should arise a recognition of this necessity, the result would be a proper matter for congratulations.

One of the elements making up the margin of ignorance in the design of steel framework is to some extent removed from that category through the information yielded by Prof. McKibben's tests, recorded on another page. These were tension tests, to rupture, of various end-connections for steel angles; they yielded figures which enable comparison of different end-connections to be made, and at the same time furnish an indication of the amount of unavoidable loss of strength incurred in a steel angle by the necessity of hitching it to a flat plate terminal. To-day (as well as in the past) every designer of steel work, when designing a tension member composed of one or more angles, determines the required size of angle by applying the full tensile unit-stress allowed in his specifications to the net area of the angle; i. e., to the gross area reduced by either one or two rivet-holes. As Prof. McKibben's test results show, the strength of angles referred to the net section averages little over 80% of the tensile strength of the metal. Consequently, when a structure is designed as above noted, it approaches about 20% nearer to rupture than would be concluded from a direct comparison of specified tensile stress with the ultimate strength of the metal. Evidently our best connections are not ideally efficient. The long-forgotten, primitive connection made by opening out and flattening the ends of an angle, to form its own connection plate, contains better possibilities.

The deductions which the tests yield, on the matter of comparative strength of different details, is much less definite, as the differences are hardly larger than the variations of individual tests, and the intended conditions are not realized with mathematical accuracy. Still, we find that, whatever conclusions are indicated, they are such as theory would suggest, in the absence of tests. Thus, an end-connection is stronger as the concentration of stress at its end is reduced, as by putting the load into it through both legs; it is slightly stronger if the pull is along the mass axis of the member; it is stronger when the weak point, the section at the first rivet, is more fully safeguarded, as by using larger rivet-stagger between the first rivets of the two rows; fracture begins in nearly all cases at the free corner of the rivet leg, where the greatest stress is found on the view that the eccentric tension produces a bending moment. The detailed table of results (which also includes the tests reported a year ago, in our issue of July 5, 1906, so that the entire series is brought together for comparison) should be studied, as the author does not give a very full analysis. We are safe in saying that it will prove reassuring to those designers who are most often accused of unnecessary theoretical refinement in designing their steel details.

However, the present attitude toward "theoretical refinements" in steel design is far different from that of fifteen, or ten, or even five years ago. The "practical" detailer who laughed at the idea of bending stresses resulting from enormous eccentricity at the heel-joint of a roof-truss no longer has the lead. Consulting engineers who call for centric joints, and even those who insist on balanced riveting, are no longer referred to as finicky cranks or men with hobbies. Details are studied and worked out with far more thorough calculation than was the case a decade ago. Experimental studies as exemplified in the tests under discussion—and their continuance, we trust—are worth a great deal in forwarding and guiding this tendency.

THE SANITARY CODE OF THE BOARD OF HEALTH OF MONTCLAIR, N. J.

The function of a local board of health is to stand between the individual citizen and some of the many dangers to health and life that beset him from without and are more or less beyond his control. Although the exercise of this function gives the citizen a large measure of protection against his own carelessness or ignorance, such a result is incidental to the primary and essentially public character of the work of a board of health.

The limitations placed upon citizens in behalf of the public health are embodied in and given legal force by formal enactments generally

known as health ordinances or, where combined in one document, a health or sanitary code. All such enactments are of course based, in turn, upon legislative authority embodied in the general health laws of the State, or in general or special city charters. Oftentimes, the delegated authority is broad and highly generalized, but sometimes detailed and specific. A health ordinance or sanitary code may be enacted by the local board of health or by the municipal council of a city. Where such legislation is not wholly in the control of the health authorities there is a strong likelihood that the health laws will be weak and behind the times, since a city council is but slightly in touch with health-protective work and is more likely than a health board to be governed by political and private interests.

Although there would be many advantages in having uniform sanitary codes throughout each State, greater progress in health-protective work will doubtless be achieved for some years to come by following the present custom of delegating local health legislation to the recognized authorities of the several municipalities. By this plan progressive communities are not held back by unprogressive ones, nor do sanitarily backward cities and towns have forced upon them legislation that is far beyond local public opinion. Moreover, a diversity of sanitary regulations, notwithstanding its drawbacks, brings out new ideas which are put to the test of practice. Where means exist for comparing results under various regulations progress may be expected.

A large volume would be required to set forth the many and diverse health ordinances now in force, although not always enforced, in this country. In fact, an attempt of this sort was made a few years ago by Dr. Charles V. Chapin, Superintendent of Health of Providence, R. I. So large was the undertaking that before Dr. Chapin's task of collecting and compiling "Municipal Sanitation in the United States" was completed much of the information was out of date. The book included, however, considerable information besides digests of sanitary codes.

What one local board of health has evolved in the way of a sanitary code during the last dozen years is shown elsewhere in this issue, where may be found a reprint in full of the recently revised sanitary code of Montclair, N. J. We speak of this code with some diffidence, inasmuch as one of the editors of Engineering News has been a member of the Montclair Board of Health since its organization, and for several years past has been its president. On this account we shall attempt no criticisms of the code, but shall merely attempt an explanation of some of its underlying principles.

As explained in the introduction to our reprint, the evolution of the Montclair code has been largely the work of the successive engineer-health-officers employed by the Montclair board since its organization. This is one of our excuses, if such be needed, for reprinting the code at length.

Like all growths to meet local needs, the Montclair code is perhaps over-developed in some parts and underdeveloped in others, and may lack features that would be essential in other communities. Some of its deficiencies, real or apparent, are due to lack of specific authority from the State legislature, and some of its radical features (by comparison with most codes) are made possible by local public opinion that is more potent, for local purposes, than any legislation yet on the statute books of New Jersey.

The general basis of restrictive legislation by boards of health is expressed in the first section of the second article of the Montclair code: "Whatever is dangerous to human health [is] hereby declared to constitute" a nuisance. This declaration is made more specific by declaring that "whatever renders the ground, the water, the air or food a hazard or an injury to human health" is a nuisance, and is made still more specific by naming such common nuisances as the accumulation of foul, decaying matter, polluted wells, and inadequately lighted or ventilated dwellings. These general and specific declarations were inserted in the code, first, as fair warnings to the public and, second, for prompt and effective possible use where prosecutions become necessary in order to prevent or abate nuisances. A nuisance, it will be understood, then, is any offense against the public health, but practically only such offenses as have been formally declared nuisances are subject to legal proceedings for abatement.

Particular attention may be directed to the fact that among the specified nuisances is "The accumulation of water in which mosquito larvae breed." This is directed against the spread of malaria. Incidentally, it promotes the peace and comfort of the citizens of the town.

Having stated both broadly and particularly what are nuisances the code proceeds to say what shall and shall not be done and how certain permissible things shall be carried out in the interests of the public health. Attention is first given to the regulation of such generally acknowledged possible nuisances as privy vaults, cesspools and manure pits, and the storage, collection and disposal of garbage and other putrescible matter. The need for regulating privies and cesspools (where these cannot be abolished, under later sections of the code) is obvious, but it is not widely understood that, aside from annoying odors, and the danger of polluting private wells, privies may endanger the public health through the agency of flies; and cesspools, likewise, by means of mosquitos. Where water accumulates in privy vaults they, also, may be breeding-places for mosquitos. Flies carry typhoid germs on their feet, from privies to pantries, kitchens and dining tables; and mosquitos, as has already been said, disseminate malaria. Manure pits, if not screened, afford breeding-places for multitudes of flies, and, if wet, for mosquitos, also.

The regulation of garbage storage and disposal has far less public-health justification than was formerly supposed, especially in relatively small, non-crowded towns. But garbage may aid in multiplying flies, and when in a decaying state it pollutes the air, although not thus giving rise to any specific disease. The public looks to boards of health for protection against whatever dangers, real and imagined, there may be in improperly stored and handled garbage, and for years to come, if not always, will continue to do so.

Spitting in public places is prohibited, chiefly on account of the spread of tuberculosis thereby, but also on account of the danger of spreading diphtheria and possibly other diseases by the same means.

Permits for keeping swine and cattle are required because of the possible odor-nuisances and fly-nuisances connected therewith, but more particularly to ensure housing or shelter conditions conducive to the health of animals used for food purposes. Such permits locate places where hogs and cows are kept, thus facilitating inspections. It is highly desirable to know the location of milch cows, kept for private use. Such cows, in towns, are liable to be kept in crowded and otherwise unsanitary quarters, favorable to the development of bovine tuberculosis and to the production of dirty, bacteria-laden milk. Frequently their milk is sold to the neighbors of their owners, but in such small quantities as to bring the cattle scarcely within the well-recognized limits of dairy cows, which are regulated in detail elsewhere in the code.

The portion of the code which deals with food, other than milk, may be less specific than that of many other towns and cities, but it is broad enough to cover the local needs of Montclair. In general, it prohibits the sale of decayed or unwholesome food of all kinds, including meat, vegetables and fruit, and provides for the protection of all foods from infection, during both manufacture and exposure for sale. Ice cream, ice, and milk in grocery stores are to be specially guarded from contamination and from conditions liable to render them unwholesome.

In the present status of health-protective work, one of the most, if not the most, important portions of a sanitary code is the one dealing with the public milk supply. This portion comprises about one-seventh of the whole Montclair code, while in the time and thought put upon drafting *and enforcing* it the ratio is even greater.

The grand object of the milk sections of the Montclair code is to ensure a milk supply free from the germs of typhoid fever, diphtheria, scarlet fever *and tuberculosis*, and at the same time free from the causes, whatever they may be, of infantile digestive disorders. One of the secondary objects of the code is to ensure to the public a nourishing article of diet, by preventing adulteration of the milk; but this, except perhaps for the infants of the poor and for invalids depending largely on a milk diet, is an economic rather than a health question, although it is the only phase of the public milk supply thus far given attention by most local boards of health.

To go into the details of the milk sections of the code (which occupy nearly two columns of small type in our reprint) is out of the question here. Some of the most important provisions are: All persons selling milk in the town must file a list of the dairies from which the milk is obtained and also a list of their customers; all dairies, stables and milk shops must be open at all times to the inspection of the board (regardless of location—in or out of town); cows must be stabled, fed and milked, and the milk must be cooled, bottled, stored and delivered, under strict sanitary conditions, named in the code; all cows must be *tuberculin tested*, and any cow which reacts to test (i. e., gives evidence of tuberculosis or "consumption") must be excluded from the herd, or else the milk of the whole herd will be shut out from the town; all dairy utensils, including bottles (and no milk can be delivered except in sealed bottles) must be *sterilized by steam*; all milk must be cooled to 50° F. or below within 45 minutes of milking, and its temperature must not exceed 50° F. up to the time of delivery; milk containing more than 100,000 bacteria per cu. cm. on two or more different days will be excluded from the town.

Lists of the customers of dealers are useful in running down the sources of outbreaks of communicable diseases. New lists may be demanded by the Montclair board at any time. The tuberculin test is required because of the possibility of the transmission of tuberculosis from cows to man and also because, quite regardless of this, milk from tuberculous cattle is not proper food for man or beast. The low temperature requirement is designed to prevent the multiplication of bacteria in milk, and the possible digestive disorders that may follow therefrom, especially among infants and children. A bacterial limit has been set, both to keep down the general bacterial content and to promote cleanliness; dirt and bacteria going together and increasing the chances of the admission of pathogenic bacteria, or disease germs, to the milk.

The Montclair milk regulations are probably more rigid than those in force *and enforced* in any other American town of less than 20,000, and are equalled by but few cities anywhere in the world. They have been framed with the cooperation of the milk dealers of the town. The generous support accorded the regulations by the public and by dealers and dairymen has been due, in no small measure, to a lesson learned a dozen years or so back, when eighty cases and thirteen deaths from typhoid fever were traced to the route of a milkman whose son was found to have had typhoid fever and to have contaminated, by way of an open privy, a well from which water was taken to wash the dairy utensils. Lesser milk-borne epidemics, particularly a diphtheria outbreak, have added to the lesson.

The registration of vital statistics may next be considered. This is at the foundation of all intelligently directed health-protective work, since the total death rate and its distribution to causes afford indexes to the efficiency of health work and the directions in which further efforts should be directed. The importance of prompt reports of the community recognized communicable diseases hardly needs to be urged here, although it is most unfortunately true that it, like the value of vital statistics generally, is not

yet recognized in thousands of American communities.

Passing over a number of articles of the code, it may be noted that failure to connect a house with a sewer, when a sewer is available for the purpose, is considered a nuisance, quite regardless of the way in which the premises are kept; and means are provided for forcing such connections and for the abolition of privies and cesspools on sewered streets.

A third of the ordinance is devoted to plumbing. In the light of our present knowledge of the origin and spread of communicable diseases this space is very disproportionate to that given to other topics. In fact, save for certain broad principles, the plumbing article might well be omitted from the code and transferred to the building ordinance of the town. The same is true of the sections devoted to gas piping. But under existing conditions in Montclair, and the same is even more notable in most other small municipalities, plumbing inspection seems to fall of necessity on the board of health. It is important that no plumbing be done without a permit, involving the approval of plans for the proposed work, and that all plumbing be inspected and tested to see that it complies with accepted sanitary rules. Plumbers and the public alike will tolerate and even respect regulations and inspections by a board of health far more willingly than by any other municipal department, and so this work, like the supervision of garbage collection and disposal, is likely to devolve upon health boards, as a general rule, for years to come.

The plumbing provisions of the Montclair code are designed to ensure tightness, durability and simplicity. The main or intercepting trap is prohibited on new work, in order to facilitate the ventilation of the public sewer, the house sewer, soil pipe and its branches. The back-venting of traps is also prohibited, as needless and otherwise objectionable, besides adding to the complication and expense of the plumbing work.

Nearly all the articles composing the Montclair sanitary code have now been briefly reviewed. The code is an evolution of a dozen years, as already stated, and will require changes to meet new conditions and a better understanding of those now being coped with. It falls far short of covering all the activities of the board, being practically silent on so important a matter as the public water supply and wholly so on such vital work as medical inspection of the schools. Such lines of work require little if anything in the way of code provisions, which are designed to prohibit certain acts or conditions, to define how other acts shall be performed, to prescribe certain duties, and to provide penalties for infractions of the code, be they sins of omission or commission.

As the years go by and sanitary science progresses and sanitary knowledge on the part of the public increases in amount and observance it is to be expected that sanitary codes will consist more and more of broad general principles and conditions and less of detailed prohibitions and commands. In other words, we may hope that even though it may always be necessary, short of the millennium, to outline the principles of public sanitation and demand compliance therewith, yet the specific methods to be followed may be safely left to the individuals concerned. With every approach to such a happy day an increasing amount of attention may be given to the legitimate and urgent work of boards of health: the prevention of communicable diseases and the upbuilding of the general healthfulness of municipal conditions, instead of being compelled to spend so much time as now in combatting fancied dangers and in alleviating annoyances which should be settled either privately or in the ordinary courts of justice. When typhoid fever and tuberculosis, to name only two readily preventable diseases, have been virtually wiped out it may then be permissible for boards of health to direct their efforts against harmless though annoying smells and to pursue imaginary disease germs borne by mythical sewer gas.

LETTERS TO THE EDITOR.

A Non-Patented Pivotal Pile-Driver.

Sir: Referring to article on p. 160, issue of Aug. 15, 1907, entitled "A Pile Trestle Erected with a Pivotal Pile-Driver," by Mr. R. Balfour: I designed, built and used an oscillating pile-driver on the Wabash Railroad in 1888, for the purpose of driving batter piles. The angle of the pile was gaged accurately by a rack and pinion movement, the leads being carried on a Howe truss design frame. Any person desiring to use this design is free to do so.

Yours truly, Charles Hansel.

43 Wall St., New York, Aug. 15, 1907.

The South American Trans-Continental Railway.

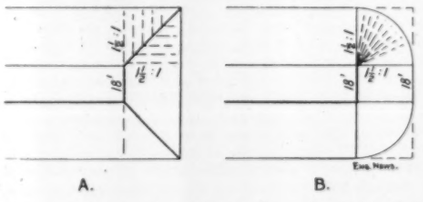
Sir: In your issue of Aug. 1, 1907, an item about the railway named reads, "This will be the first place at which the Andes have ever been crossed by a railway." This is an error. The Andes were crossed early in 1893 by two standard gage railways—the Central of Peru, from Callao; and the Juliaca and Cuzco, in the southern part of that country. Both start on the Pacific, cross the Andes, and go down branches of the Amazon; but navigable water is yet far ahead of them, and the road mentioned may be the first trans-Continental railway.

Jas. R. Maxwell,
(Late) Chief Engineer Ferro Carril del Peru.

Newark, Del., Aug. 2, 1907.

What Shape Has the End of a Railway Embankment.

Sir: From a theoretical standpoint, should a head of bank on a fill for railway roadbed be considered as a piece of continuous embankment cut by a plane (like A in the sketch herewith) or as a piece of embankment



A. B.

with square end supplemented by two conic sections of 90° angle and a wedge (as per B in the sketch).

I have had some discussion on the subject and wish your decision. Yours truly,

John P. Algie.

Lavina, Mont., July 29, 1907.

[We beg to be excused from attempting a "decision." The question might serve as subject for an entertaining discussion over the lunch table, from a theoretical standpoint. From a practical standpoint the query suggests itself why the dirt should be expected to go out to the corners, in sketch A.—Ed.]

Bending Rails by Machinery.

Sir: I notice in your issue of Aug. 1 an article on "Bending Rails by Machinery," and one might judge from the article that this is an entirely new proposition. I therefore desire to call attention to the fact that over 15 years ago, while Roadmaster on the Northern Pacific Ry. between St. Paul and Minneapolis (and also on western divisions) I curved all of the rails in the manner described in your article. Instead of a hoisting engine I used a locomotive for the power to pull the rail through the bender. Many miles of rails have been bent in this manner. I do not see why those in charge of such work pursue the ordinary methods of bending by hand power when a car load of rails can be bent by the use of a locomotive in a few minutes, if properly rigged up for doing the work.

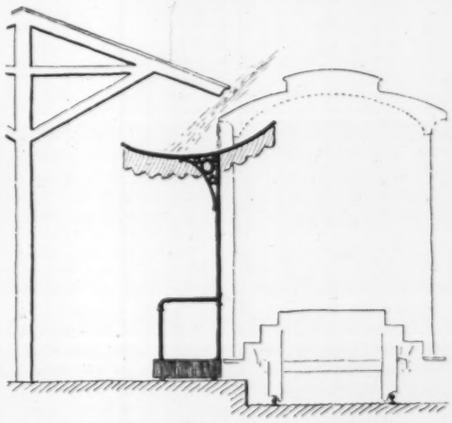
C. L. Bartlett.
(Bartlett & Kling, Contractors.)

Cedar Rapids, Iowa, Aug. 6, 1907.

[The fact that mechanical power is rarely applied in the work of bending rails makes applications of this kind of particular interest. In one method described in the article above referred to the bending roll is driven by gearing, and the rail thus forced through by the action of the roll. In the other method the rail is pulled through by a cable and engine, and this would seem to be more simple, besides working more rapidly. The use of a hoisting engine would be preferable to running a locomotive to and fro to do the work, especially as the hoisting engine could be utilized in handling the rails. Either the geared or cable arrangement could readily be mounted on a platform car, for use on the track or at points where rails are stored.—Ed.]

A Device to Promote Railway Passengers' Comfort in Rainy Weather.

Sir: Very many of our important railway stations use the individual umbrella-roofed platforms instead of one great train-shed; and, do what they will with these sheds, whether the roof lips over the car-roof or is flush with it or below it, there is bound to be dripping in a rain-storm and consequent discomfort to passengers getting



A Device to Prevent Rain from Inconveniencing Railway Passengers at Stations.

on and off. A preventive or cure that might be installed suggests itself to me; a little movable step, covered, forming a sort of entry to at least the Pullman cars. The accompanying diagram explains it.

The sketch roughly outlines the posts and covering over the platform, the car, car-platform and road-bed. The little carpeted platform, on rollers, would become part of the first step, or an additional step, instead of the porter's stool—dependent upon arrangement of road-bed and height of platform. The roof bars would be arranged to lip under the doorways of both Pullmans and project well under the platform roof. This light frame would be covered with heavy awning, so arranged as to carry the water off at the sides. Passengers and employees would thus be completely protected from rain-drip or the beating in of rain through the gap at the edge of the shed roof. When not in use these umbrella affairs could be tucked out of the way in the middle of the platform.

This is merely a suggestion from one who has no objection to getting wet himself, but has heard the growlings and seen the apparent discomfort of his fellow travelers, lo, many a time. No Name.

Washington, D. C., Aug. 1, 1907.

The Use of Salts of Lithium in Testing Underground Waters for Pollution.

Sir: I have been interested in reading your abstract of the paper by Dr. Thresh on "The Detection of Pollution in Underground Waters" (Eng. News, Aug. 1, 1907). I note that while speaking of the use of a salt of lithium for well-testing he says: "Owing to its cost and the difficulties of detecting it in water it is now rarely employed."

It is true that the chemical means available for the detection of lithium are none of the simplest, but it is most readily detected by the spectroscope. Having shown lithium to be normally absent from the residue obtained after evaporation of the water to dryness, the fine crimson line of its spectrum will give easy proof of its presence should it reach the well after "salting" the point of suspected pollution with the chloride of the metal. Yours very truly,

W. P. Mason.

Troy, N. Y., Aug. 5, 1907.

Protection of Automobiles at Grade-Crossings of Roads and Railways.

Sir: One hears so much in the daily papers of accidents to automobiles at railroad crossings where no flagman is regularly stationed, that I beg to suggest that a few words in your editorial columns as to your own opinions and remedy for this evil, would certainly be a welcome and wise thought.

Personally, I have had some narrow escapes, and I rather flatter myself that I approach railroad crossings always with great caution and slow speed. However, it is absolutely impossible to hear the small electric bell which some crossings have (and some crossings, also, are without) owing to the noise of one's own motor in

the automobile. In fact, the noise even of the approaching train is something which cannot be heard.

Nine times out of ten, also, these railroad crossings without flagmen are upon narrow roads through the woods, where absolutely no sight up or down the track can be gained. It seems to me that something more than an electric bell should be put at these crossings, as even a noisy, heavy wagon loaded with brick or other merchandise cannot hear the signal of the approaching train. Some visual signal, like a semaphore arm, ought to be employed upon the approach of a train in either direction. This might well be connected in some way with the rather common electric warning bell above mentioned.

Thanking you for any suggestion on this subject which you may make,

Yours very truly, L. F. Buff.

Jamaica Plain, Boston, Mass., Aug. 14, 1907.

[Not many years ago a public demonstration was given in New York City to prove that an automobile can be stopped in a shorter distance than, or at the very least in as short a distance as, a horse-drawn vehicle, even though its speed be much greater than that of the latter. Reasoning from this demonstration, we should judge that a horse-drawn vehicle is exposed to as much danger of collision as the other. In the age of the horse, the question of protecting railway crossings led toward the view that all railway-road crossings at grade should be abolished by being converted to over or under crossings. It has always been acknowledged that the warning bell is only a make-shift sort of protection. If the automobile offers any greater reason for abolishing grade-crossings, or makes it more urgent to accomplish complete abolition of such crossings at the earliest possible moment, we must consider it an error to convert this fact into a plea for putting up semaphores, in other words mere signals of danger, instead of using it to hasten the abolition of the danger itself.

If, however, signals be thought desirable, we would propose a different form. The semaphore is inadequate. No motor-car driver has his eye up among the telephone wires, where the semaphore arm would have to be, in the general case; nor is he, ordinarily, inclined to come to a stop for so non-imperative a warning as a semaphore. The proper signal to meet the needs of the case would be a lay figure arranged to rise up out of the middle of the road; it being known that all automobilists stop when a person is in their path. Perhaps even more effective as a stop signal would be a 24-in. I-beam arranged to drop across the road like a toll-gate, but seating in substantial sockets. This would carry with it its own enforcement of obedience to the signal indication.—Ed.]

The Electrical Engineers' Proposed Code of Ethics.

Sir: Undoubtedly engineering is a profession, be it the civil, mining, mechanical or, the youngest of all, the electrical branch which is followed. In its infancy engineering was developed in the arts of war, and later those who followed peaceful lines were distinguished from their military brethren by the adoption of the term Civil to denote that their efforts were to be directed toward the overcoming of natural obstacles met in public and private works, not connected with the military establishment. The mining, mechanical and the electrical engineers are but specialists along certain lines of civil engineering. The code of ethics recently proposed by a committee of the American Institute of Electrical Engineers is, therefore, for certain specializing engineers, and it would probably be better if some code of ethics were devised to cover the broad profession as a whole.

But there is some doubt as to the necessity for any such code. It is true that three other professions, or lines of activity, have codes for the government of their members, these being the law, medicine and architecture, though it is possible that the latter might not be considered a code of ethics except by some slight straining of the term. The relation between the doctor and his patient, or that of the lawyer to his client, has been recognized before the courts for years as being of a confidential character entailing certain obligations. The relationship between the engineer or architect is rather of a different order from that of the lawyer or physician. A case placed in the hands of the doctor or the lawyer is under his management and its orderly progress is directed by him, not by the client, though the client is bound legally by his acts in as far as such acts affect the case at issue; the engineer, be he consulting engineer, architect or employee, is governed by an entirely different legal status.

With the foregoing in view it is interesting to analyze this engineering relationship. Comparatively few engineers are engaged in consulting practice and when an engineer is an employee his relationship is legally governed by the law of "Master and servant," which would hardly recognize any code of ethics. As an employee the engineer carries out the details, but his relationship to the work in hand is only legalized by the employer. Unless aside from his engineering relationship the engineer is empowered with executive authority, he cannot bind his employer and his acts are usually not valid unless confirmed by an executive. When the engineer is engaged as a consultant this same limitation of his authority exists, and he is not in a position to commit his client, except in those exceptional cases where he is specifically authorized to do so, and this latter relationship is extraordinary, and he would be in the same legal status as any other agent who is subject to the instructions of his principal. In fact the entire relationship between the engineer and his client is similar to the business relationships existing between buyer and seller, and it is up to the engineer to deliver the goods, and this is the case with either the consultant or the employee. If the services rendered are unsatisfactory it is the customer or employer who determines this fact, not the engineer.

The code of ethics, which does not recognize the principles of common law entailed in the relationships of those who adopt it, will stand as a monument to the folly of its builders. It would be idle to comment on the proposed code of ethics in detail as it has not been adopted; but the following from the letter transmitting it to the institute furnishes a glowing side light on the views of its constructors (the italics are the writer's):

While we do not consider it practicable at this time to formulate a code of ethics covering all of the conditions which the engineer may meet in his work, we do consider it both practicable and desirable to record some of the general principles of professional conduct that should be a guide for the electrical engineer, *leaving it to him to make specific application to the cases which he may meet.*

In view of the well-known positions of the formulators of this proposed code, and their ability, as engineers, business men and writers, and their expressed doubts as to the practicability of such a code; it would be interesting to know why they did not edit their production and reduce it to a single sentence. This could have been done if they had only been willing to plagiarize from the Bible: "Do unto others as you would have them do unto you." The advantage of this terse summary lies in the fact that it should apply not to a limited line of specialists but to all. As for the code of ethics proposed, requiescat in pace.

A. D. Williams, Jr.

East Liberty, Pittsburg, Pa.

Sir: I have seen several criticisms of the "Code of Ethics" proposed by a committee of the American Institute of Electrical Engineers, but have not yet seen any comment on Article 15, which, in part, is as follows:

> If the problem solved by the engineer is met in the pursuit of his work for his employer, and is not of such a character that his attention would have been directed to it regardless of his relations to his employer, the products of his work, in the form of inventions, plans, designs, etc., are not his private property, but the property of his employer, *though the engineer may be entitled to special remuneration for such inventions* (?) *etc.*

This paragraph is not good English, for its last clause contradicts what goes before. It is not good ethics, nor good law. I had occasion some twenty years ago to look into the law of this question, and found that there was an unbroken series of decisions to the effect that an employee's inventions were his own unless he had contracted to give them to his employer.

An electrical engineer may be employed on the installation of a railway; he may be employed by the consulting engineer, or by a contractor, or by the railway company. While so engaged he invents an improvement in railway motors. By what rule of law or ethics is he under any obligation to assign his patent to his employer?

Yours truly Wm. Kent.

Syracuse University, Syracuse, N. Y., Aug. 8, 1907.

On a Suggested Method for Extrapolating Values of Stream Discharge.

Sir: In your issue of July 18, 1907, Mr. J. C. Stevens gives a method of expressing the discharge of a stream as a function of $Av\sqrt{d}$, A being the area of cross-section and d the hydraulic mean depth. The object of using this auxiliary function is to reduce the discharge curve to a straight line. A straight line can be extended accurately beyond the limits of known coordinates, while a curve, such as an ordinary stream discharge curve, whose equation is unknown, cannot be accurately extended.

The difficulty and uncertainty of extending a stream discharge curve beyond the limits of the measurements is illustrated by an "estimate" of the discharge of Chemung River, made by persons unfamiliar with the locality, from data furnished by the writer covering gage heights up to about 7 ft. only. The "estimated" values are given in the second column of the following tabulation, and the discharge as determined later by actual measurements is given in column 3.

Gage height, ft.	Estimated discharge, cu. ft. per sec.	Measured discharge, cu. ft. per sec.
8.84	14,980	13,800
9.46	16,840	16,480
11.39	22,630	25,800
12.10	24,760	29,340

In this case, the attempt had been made to extend the discharge curve as a straight line, tangential to the curve at the limit of the actual measurements.

It can easily be shown that the discharge curve for concave open-channel cross-sections can never become a straight line, and in order to reduce it to a straight line to facilitate its accurate extension, special methods must be resorted to.

Any method by which a stream-discharge curve may be reduced to a straight line, and hence extended to stages above those covered by discharge observations is of great value. Years may elapse before an extreme flood stage of a stream is repeated, making it possible to get measurements of the discharge. With a suitable method of extension it may be possible to form a reasonable estimate of the discharge in the highest recorded floods, from measurements made at somewhat lower stages. To apply Mr. Stevens' method, the area of cross-section and wetted perimeter must be known up to the highest stages, in order that the curve of $Av\sqrt{d}$ can be extended. Without this curve the discharge cannot be determined, since it is only expressed indirectly as a function of the gage height. Unfortunately the published results of stream measurements by the U. S. Geological Survey do not, as a rule, contain any data regarding the effective cross-sections of streams above the limit of the discharge measurements.

In cases where the necessary data are available, it is probable that Mr. Stevens' method gives the best results of any that can be devised. It appears, however, that Mr. Stevens makes an unnecessarily derogatory reference to the use of logarithmic cross-section paper, for the straight line extension of discharge curves.

The discharge curve for Umatilla River given by Mr. Stevens for stages above 6 ft. can be expressed as accurately as it can be read from Mr. Stevens' diagram, by means of the formula:

$$\text{Cu. ft. per sec.} = 540\ (\text{Gage Height} - 2)^{1.58}$$

This equation is the symbolic expression for a straight line plotted on logarithmic paper. It expresses the discharge directly in terms of the gage height, without the use of an auxiliary function. Such logarithmic charts can safely be used for the extension of discharge curves beyond the limits of actual measurements in many cases. They express empirically the law of discharge, over a certain range of gage heights, and their use for extending the curve to higher stages involves only the assumption that the law of discharge remains the same. Experience shows that this usually holds true for a stream confined within banks at all stages, as is the case with Umatilla River, up to the limit of Mr. Stevens' curve. If the stream spreads over flats or enters by-pass channels at higher stages, such extension methods may still be used for the main channel discharge, the other flow requiring separate estimation.

As a rule, a logarithmic line representing the upper stages of a stream will not correctly represent the lower stages. The writer has satisfied himself that this is because the law of discharge of a stream cross-section at low stages is usually different from that at higher stages. My attention was called to this in 1901 by the use of a method analogous to that of Mr. Stevens. Curves of the mean value of $CA\sqrt{d}$ were plotted for various sections of the Mohawk River, each section being terminated by gages from which the slope was determined. The discharge was also determined independently of the slope. It was found that the Chezy-Kutter formula gave reliable results for flood stages, but gave much too large results for lower stages. This was apparently due to the fact that the bed of this stream, like most others, comprised alternate reaches of swift and sluggish water at low stages. The slope sections were too long, covering more than a single reach. In low water, the surface slope in each natural reach controls its discharge. Most of the fall occurs in the swift water reaches. The velocity varies nearly as the square root of the slope, and hence the mean velocity in the whole gaging section was much less than the velocity computed from the fall. As the stage increases, the local obstructions are drowned out, the reaches are merged, and the local surface slope approaches equality with the general slope over long reaches. These and later investigations showed that the slope varied somewhat systematically with the stage, increasing in some reaches, and decreasing in others as the stage increased. In other words, the slope at any given cross-section was not constant as it is assumed to be in Mr. Stevens' paper, but was itself a function of the gage height.

Yours very truly,

Robert E. Horton,
Hydraulic Engineer.

481 Hudson Ave., Albany, N. Y., July 30, 1907.

Sir: The method of developing a station rating curve from a single or a few gagings, described by Mr. J. C. Stevens in Engineering News of July 18, is not generally applicable. It may give discharge with sufficient accuracy for a deep, sluggish stream, but not for a shallow, rapid one. This fact is more clearly seen from the formula for velocity than from the formula for discharge. Dividing the equation $q = K A \sqrt{R}$ by the cross section area we have $v = K \sqrt{R}$. If K is a constant as assumed by Mr. Stevens, the velocity is independent of the slope—a surprising statement. [Rather, the assumption is that the slope is constant, its value being contained in K.—Ed.]

To show that a very serious error may be made in some cases by the use of this formula, we may use data recently obtained on the Calaveras River near Jenny Lind, Cal. For a stage of 1.7 ft., v = 1.38 ft. per sec. (obtained with a current meter), R = 3.4 ft., A = 431 sq. ft., q = 593 sec-ft. and the surface slope giving this velocity is s = 0.00015. For a stage of 13.2 ft., A = 3,159 sq. ft., R = 10.2 ft., and the surface slope s = 0.00307. From the above formula v = 2.37 ft., while from Kutter's formula v = 12.8 ft. per sec.

Mr. Stevens would not apply his method to this case; it is a very common case, however, and he has not given a criterion for deciding when not to apply it.

The writer does not believe it is necessary or wise to assume that the surface slope is constant. It can easily be measured and used in computing the discharge. All the slope and cross-section data necessary to develop a station rating curve for preliminary estimates of discharge can be obtained in half a day of field-work. The coefficient of roughness "n" can be computed from a measurement of discharge (with a current-meter) and the corresponding surface slope. Is it not better to spend half a day in the field getting slope and cross-section data, than to use a method that may involve large errors?

Very truly yours,
E. C. Murphy,
Engineer, U. S. Geological Survey.

2338 Carlton St., Berkeley, Cal., July 26, 1907.

Sir: Referring to an article in Engineering News for July 18 by Mr. J. C. Stevens, I would like to make a criticism of his method of gaging streams. In Kutter's formula, $Q = A C \sqrt{r s}$; A is the area of the cross-section, s is the slope, r is the hydraulic radius, or area divided by wetted perimeter, and

$$C = \frac{23 + \frac{1}{n} + \frac{.00155}{s}}{.5521 + \left[23 + \frac{.00155}{s}\right]\frac{n}{\sqrt{r}}}$$

in which n = coefficient of roughness.

Mr. Stevens makes the statement that for the same location the expression $C \sqrt{s}$ remains practically constant. To show that this statement should be qualified, two river sections (A) and (B) are given and the value of C computed, s, the slope, being constant.

Section A: A channel 350 ft. wide, with sides approximately vertical and bed horizontal; coefficient of roughness remains practically constant at 0.03 at all stages. At low stage, depth = 10 ft., area of cross-section = 3,500 sq. ft., wetted perimeter = 370 ft., hydraulic radius = 9.5 ft.; C = 73. When the water rises to 25-ft. stage, the area becomes 8,750 sq. ft., wetted perimtter 400 ft., hydraulic radius 22 ft., and C becomes 81.

Section B: A channel having low banks bordered by fairly level ground. At low water A = 800 sq. ft., r = 8 ft., n = 0.25, and C = 82. A slight flood sends the river out over the level but rough banks, decreasing the hydraulic radius and giving a high value to "n." At high water A = 4,000 sq. ft., r = 4 ft., n = 0.05, and C = 38.

In (A) the change in the value of C from low water to high water is about 10%; this is unusually low variation, as it is seldom that the section has perpendicular sides or that "n" does not change. (B) represents more nearly the common river bed, and in this case the variation is over 100%.

In assuming that "r" may be taken equal to the mean depth, another error creeps into the problem amounting to fully 20% in some cases. If there was a good reason for using such inaccurate formulas there might be some excuse for simplifying Kutter's, but the writer knows of no reason why the engineer should not establish the correct values for "C" for the various gage heights. The wetted perimeter is as easily determined as the average depth, as it is the depth gagings from which the profile is drawn, and it is not then difficult to scale off the wetted perimeter.

Yours truly,
R. C. Beardsley.

Cleveland, Ohio, Aug. 2, 1907.

[The last suggestion of Mr. Murphy is not applicable, of course, to cases such as those primarily referred to in Mr. Stevens' article. As we understand it, they are those cases in which flood-discharges cannot be measured directly, because very rare, while the extreme flood height is known from marks or records or is assumed. The surface slope for these stages would therefore not be a known quantity.

Objection may be made on one score to the implied comparison, in Mr. Horton's letter, between the method described by Mr. Stevens and the method of plotting the discharge curve itself on logarithmic paper. The derived curve includes something more than the original discharge curve, by taking into account the value $A \sqrt{a}$. Therefore the continuous straight line of q plotted on $A \sqrt{d}$ does not necessarily correspond to a mathematically continuous curve on gage-height as abscissas. For if $A \sqrt{d}$ changes its manner of variation above a certain gage-height, then the relation between the two discharge curves is also changed. Under these circumstances, comparing Mr. Stevens' straight-line curve with the logarithmic plot of the discharge-H curve, one of these might remain straight while the other becomes curved.—Ed.]

Notes and Queries.

In our issue of July 18, 1907, we described the concrete used in the Bridgman Building in Philadelphia as hand mixed, one of the foremen on the work having so informed a member of our staff. We have recently been advised by a member of the Philadelphia Bureau of Building Inspection that the concrete was mixed in a batch mixer. This invalidates the specific criticism made against the concrete in this building by Mr. C. H. Marquess, in a letter in our issue of Aug. 8, 1907, though in no way detracting from his argument against the general use of hand-mixed concrete.

THE DEVELOPMENT OF STANDARD LIGHTNING PROTECTION FOR POWER PLANT CHIMNEYS AT UNITED STATES NAVY YARDS.*

By N. M. HOPKINS,† Assoc. Am. Inst. E. E.

In the design of a modern central light and power plant for military purposes reliability of operation is the first essential. A breakdown of one of the new central power stations, or even a temporary failure to supply the important shops of construction and repair, equipment, ordnance and engineering, or the great electric pumps for emptying the dry docks, might, at a critical time, mean the defeat of a fleet. Insomuch as minute attention is given to the design of the machinery in duplicate and in triplicate, according to the best and most approved engineering practice, the work would be incomplete if the buildings and chimneys were not given the best protection from violent lightning strokes that modern practice can afford.

It has been with the view of providing chimney protection commensurate with the importance of the power plant to the naval service, that the writer took up the design of the lightning protection herein described. There are few devices in the field of applied electricity or electrical engineering regarded with greater skepticism and distrust than the lightning rod, but unfortunately so, for its reputation has been based in the majority of cases upon the old incorrectly applied conductors of Benjamin Franklin's day. The early rods were put up with the idea that a lightning stroke took the form of a direct-current flash to earth, that it was attracted and influenced by the presence of iron or steel, and incapable of turning sharp corners or passing through glass insulators. As the result of carefully conducted researches upon lightning strokes and phenomena, both in this country and abroad, the old Franklin rod has evolved into the correctly designed and erected lightning conductor, the value of which has been thoroughly demonstrated. According to the latest views, lightning does not strike a direct blow to earth, nor possess inertia-like qualities which prevent it from turning sharp corners. The belief in its inability to pass through glass insulators has been abandoned also, and the danger of using insulators, for other reasons, has been fully demonstrated.

The design illustrated and described in the present paper was completed after a careful study of recent English and Continental systems, as well as American practice. The writer has, in addition, tested several of the latest theories by practice and experiment, and reproduces herein a few of the typical experiments with apparatus capable of giving high electrical pressures at very high frequencies. In dealing with powerful oscillatory electrical discharges many complex factors must be considered in what is generally termed the circuit. The mathematical laws governing the deportment of direct currents are wholly inadequate where lightning discharges of oscillatory character are concerned, and it has been in connection with the study of proper protection for tall power-plant chimneys that some remarkable phenomena have been noted. It is not generally known or appreciated that the column of hot smoke and gases within a tall chimney conducts as well and at times better, than the metal rods outside. This point has been taken into account in the design of the lightning equipment for the power plants of the Navy. The modern theory of lightning protection is one of quiet equalization or neutralization of unlike electrical charges, as outlined in the following extract from an earlier treatise* by the present writer:

Although the old conductor of Franklin, but partially correct in application, carefully insulated from the building to which it was attached, occasionally, or we may, perhaps, say frequently, failed to afford protection when actually struck by lightning, it may be safely asserted that thousands of buildings have been silently shielded from demolition and the dwellers unconsciously protected, through the silent equalizing action of the old rod depending upon the effect of static electrical induction. This electrical phenomenon, but imperfectly anticipated by the old inventor philosopher, yearly caused his rod to shield these buildings without receiving credit, because of the silent and, apart from the glow of blue light at the rod tips, undemonstrative action. Franklin's rod was, and is yet, carefully kept from contact with the building by mounting it upon glass insulators, overtopping gables and chimneys for the purpose of receiving a lightning stroke should an electrical cloud come dangerously near, and of offering it a metallic path to earth, which it would follow in preference to that offered by the material of the building.

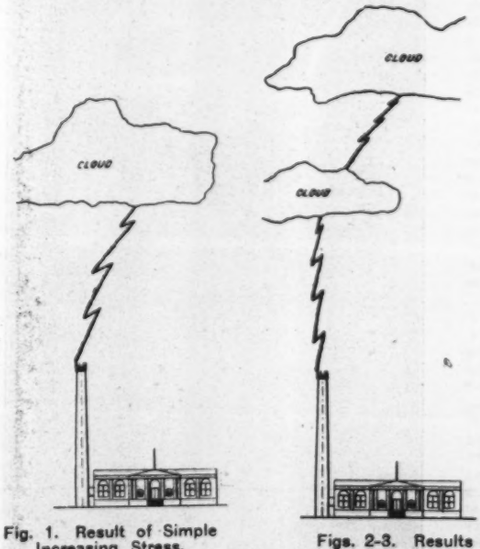
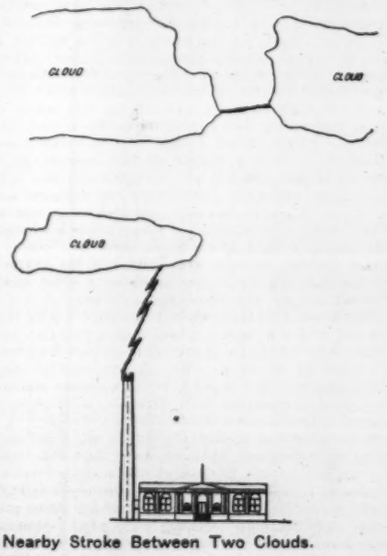


Fig. 1. Result of Simple Increasing Stress.



Figs. 2-3. Results of Nearby Stroke Between Two Clouds.

FIGS. 1-3. LIGHTNING STROKES TO EARTH.

*From Journal of the American Society of Naval Engineers, May, 1907.

†Electrical Engineer, Bureau of Yards and Docks, Navy Department, Washington, D. C.

*"Approved Lightning Protection." Hopkins, Nevil Monroe. Ill. "Sci. Am. Supp.," No. 1212, p. 19,434, March 25, 1899.

The correct and true rod should not be erected to actually receive a lightning stroke, but to prevent any flash from taking place by a quiet, equalizing action.

It appears from a careful study of lightning strokes that there are two classes of discharge, either of them being capable of demolishing a chimney if not properly provided for. The following* is based upon Sir Oliver Lodge's views on electrical storms:

It has been pointed out by Sir Oliver Lodge that lightning discharges are of two distinct characters, which he has named the A and B flash, respectively. The A

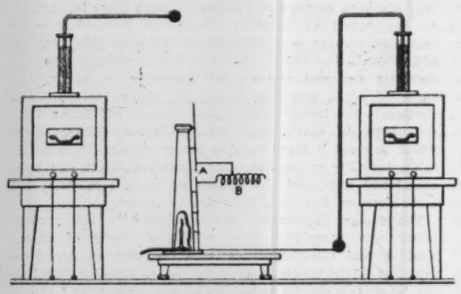


Fig. 4. General Arrangement of Experimental Lightning Apparatus. U. S. Navy Experiments.

flash is of the simple type which arises when an electrically-charged cloud approaches the surface of the earth without an intermediate cloud intervening, and under these conditions the ordinary type of lightning conductor acts in two ways: first, by silent discharge; and secondly, by absorbing the energy of a disruptive discharge. In the second type, B, where another cloud intervenes between the cloud carrying the primary charge and the earth, the two clouds practically form a condenser; and when a discharge from the first takes place into the second the free charge on the earth side of the lower cloud is suddenly relieved, and the disruptive discharge from the latter to the earth takes such an erratic course that no series of lightning conductors of the hitherto recognized type suffice to protect the building. The difference in character between the A flash and B flash, as named and described by Sir Oliver Lodge, may be more fully appreciated by referring to the accompanying illustrations. Here we have depicted a power plant, with its tall chimney subjected to the two kinds of lightning strain and stroke. In Fig. 1 we have before the actual stroke takes place, if it takes place at all, an inductive effect, and quiet, equalizing brush discharge, which may, if a sufficient number of sharp points are provided, actually prevent the disruptive discharge or stroke taking place. The A class may be looked upon as producing a steady stress, which may be quietly taken care of without damage to the chimney, if provided with a correctly designed and applied system of conductors. In Figs. 2 and 3 conditions are represented which give rise to the B class of strain and stroke, that which is far more difficult to safely handle by any system of conductors. In Fig. 2, an A type of flash between the two clouds precipitates a B type of flash between the lower cloud and the chimney top. In this case, the lightning conductors with their points upon the chimney, are not subjected to the preliminary inductive effect and stress, which may be dispelled by a silent brush discharge. In the simple A class of discharge there is a steady electrical pressure between the cloud and the sharp point of the lightning conductors, allowing a silent discharge through the air, and preventing a stroke.

This brush discharge, which is accompanied by the production of ozone, seems to establish a path for the discharge between the cloud and chimney, partly neutralizing its force by so doing. As already pointed out, the heated gases from a chimney act in a similar manner and will lead a discharge to a fireplace, a stove or other source of heated gases, in a dangerous manner. A properly designed and applied rod will in the great majority of cases prevent this discharge down flues and chimneys. In the case of the B class of discharge, a neutralizing discharge is almost wholly absent, the stress establishing itself so suddenly that an actual stroke takes place at once, the lightning striking with great violence any prominent part of the building. Figure 3 shows further how the A class of discharge may precipitate the B class, which takes place with such sudden violence. The only known means to protect a building against this B class of sudden disruptive discharge is by enclosing it within a wire cage, as shown by Clerk Maxwell.† This cage-like protection, although impractical to carry out fully, for various reasons, has been approached in the present four-conductor rod arranged about a chimney according to the appended specifications and drawings.

The writer has demonstrated by experiment, that four symmetrically placed rods afford a very efficient cage-like protection to chimneys constructed on a miniature scale and subjected to the high-potential, high-frequency, electrical discharge from a Tesla oscillator capable of striking through an air gap of 4 ft.

The experimental equipment for studying the behavior and effects of high-potential, high-frequency discharges upon a model chimney is illustrated in Fig. 4. It is estimated that the model chimney and conductors are subjected to an electrical discharge at a pressure of about 1,800,000 volts, with a frequency of 200,000 oscillations per second. As will be seen, means are here provided for the establishment of an ascending current of heated gases within the chimney, by means of a Bunsen burner. It will be noted that means are also provided for breaking or opening the conductor, and also for introducing impedance in the circuit to earth. By lengthening the gap in the conductor at A (Fig. 4), and increasing the impedance at B, the conductivity of the conductors to these high-potential, high-frequency discharges can be balanced against the conductivity of the heated column of gases within the chimney, which consists principally of carbon dioxide and water in the form of vapor resulting from the combustion of the gaseous fuel within the Bunsen burner.

FIG. 5. DIAGRAM OF APPARATUS TO DETERMINE EFFECTS OF SHARP BENDS IN LIGHTNING CONDUCTORS; U. S. NAVY EXPERIMENTS.

It is easily shown that because of the great "skin effect" of high potential discharges of high frequency a discharge may descend within the chimney, tearing it to pieces from the inside, in spite of the conductors on the outside. To protect the chimneys from destruction from this character of stroke, a heavy copper spider is provided as indicated in the drawings accompanying the appended specifications. This spider covers the top of the chimney, the radial limbs of which run to the vertical rods. A discharge may now be directed to the ascending current of hot gases, but will strike the spider and be dissipated radially at right angles to the conductors running to earth. As it has been held for many years that lightning strokes will not readily change their directions abruptly, or pass around sharp corners, it was deemed desirable to carry on some experiments to determine whether or not it was safe to eliminate from the design all easy or rounded bends.

As the installation of the spider referred to required for the protection of the interior of the chimney a right-angle deflection to the conductors to earth, experiments were made with conductors of various shapes involving sharp bends and reversals of direction. Figure 5 shows some of the forms of conductors experimented with arranged across a variable air gap. It was demonstrated that these high-frequency discharges of enormous voltages pass readily around various kinds of sharp bends and reversals in direction, as shown at A, B, C, [illegible] in the figures. With any path of the nature of [illegible] as shown at F, however, we of course introduce [illegible] pedance, as naturally would be expected with [illegible] of this kind. A full description of all exp[illegible] made, or a complete record from the writer's [illegible] upon experimental lines, would hardly be in pla[illegible] for the present article endeavors rather to pre[illegible] engineering features dealing with the practical [illegible] tion of conductors to tall brick chimneys. It [illegible] the intention, therefore, to introduce only such [illegible] experiments as to show reasons for the salient [illegible] of the general design of the specifications wh[illegible] given at the close of this paper. Figure 6 is [illegible] photograph of the model pasteboard chimney experimented with. This illustrates how a B class of discharge may strike a sudden and vicious blow of oscillatory character. Here we must have ample copper area as well as conductor capacity to carry the discharge current to earth.

In this experiment the chimney top is provided with a copper spider spanning the opening, the limbs of which run radially to the four conductors to earth. The scale of the model chimney is indicated by the Bunsen burner at the right in the foreground, as well as by the ordinary 16-c. p. incandescent lamp lying alongside. The stand with glass column at the extreme right supports the impedance coil, which may be varied in inductive value and be inserted in any of the conductors to ground under experiment. In the photograph, Fig. 6, we have the same chimney represented, but with the copper spider removed and exhibited at the base, the Bunsen burner being lighted within the chimney. The flash is shown striking down the interior of the chimney [illegible]ed by the carbonic acid gas and water vapor from the burning fuel in the burner. Figure 8 shows the same chimney subjected to the discharge from an electrical oscillator at close range, where the electrical stress is so great that all the eight points about the chimney top take part in dissipating the energy. This experiment repre[illegible]ts con-

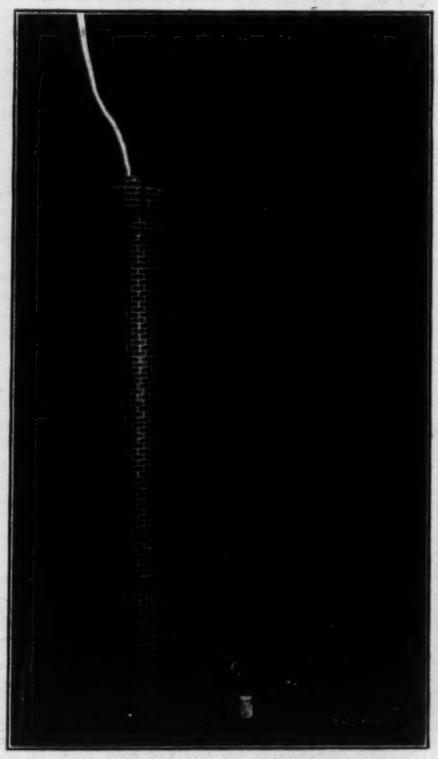


Fig. 6. Chimney Without Protecting Cage.

Fig. 7. Chimney With Protecting Cage.

FIG. 6-7. HIGH TENSION, HIGH FREQUENCY DISCHARGE TO MODEL CHIMNEY; U. S. NAVY EXPERIMENTS.

*Lightning Research Committee report of April 10th, 1905. Great Britain.

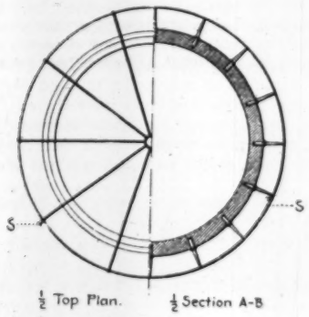
†"Philosophical Magazine," August, 1899.

ditions analogous to the class A discharge. Figure 9 shows a model pasteboard power-house and chimney with system of conductors under the discharge of an oscillator working at diminished power but at closer range. Brush discharges are quite plainly visible from the tips of the vertical rods on the roof top. The importance of a sufficient number of sharp points surmounting all conductors cannot be overestimated.

The following is translated from the German,* upon the subject of providing ample streaming or equalizing points:

The buildings of a manufacturing plant are connected by means of barbed wire strung on poles. By the connection of the barbed wire to the walls of the deeper lying buildings, a Faraday-cage-like protection is secured on the one hand, and on the other, on account of the numerous points on the wires, a more intense equalization of the electric tension between the earth and the clouds is reached. In a dynamite factory, for example, without cartridge buildings, it is necessary to have a combination of 7 buildings with about 6,000 meters of barbed wire, 1,200,000 barbed points and 70 pole earth-conductors, and it can be readily understood that by this arrangement a stroke of lightning on such a system of barbed-wire nets dissipates its electric energy and is led to earth without leaping aside or forming secondary currents. Assembled nitroglycerine factories, dynamite magazines, and in part also the drying houses, possess this barbed wire netting protection, so that the aggregate of barbed wire points on the floor space of the Krümmel factory consists of more than 5,000,000.

For the complete protection of a central power plant, therefore, its roof and trusses, together with all other



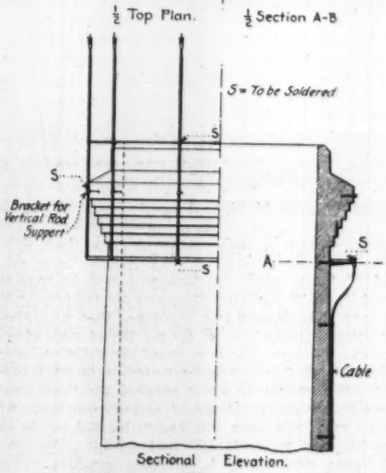


Fig. 10. General Arrangement of Chimney-Top Lightning Protection; U. S. Navy Standard Specifications.

masses of metal without and within the building, should be metallically connected with chimney conductors as well as to light rods running along the top of all roofing and other prominent parts of the building. Sharp points should be placed at close intervals somewhat analogous to the protection afforded by the barbed wire lines as described in the German article. As the architecture of the building must necessarily dictate the precise arrangement of conductors, the specifications as herein given pertain only to the protection of the chimney which, if properly provided for, because of its towering height, affords also good protection for the building. The present paper closes with the following specifications as approved for the protection of the brick power-plant chimneys of the Navy:

U. S. NAVY STANDARD SPECIFICATION FOR LIGHTNING RODS.

CHIMNEY PROTECTION FOR POWER PLANTS.—Lightning conductors shall be laid up in the form of a seven-strand cable, and each strand laid up with seven copper wires of No. 10 B. & S. gage. For chimneys of 50 ft. and less in height, two lightning conductors shall be used. For chimneys over 50 ft., up to and including 100 ft., three conductors shall be installed. For chimneys higher than 100 ft., four conductors shall be installed. All heights to be considered from ground level. All conductors or cables shall be symmetrically arranged about the chimney with one cable on the prevailing weather side of the chimney. Said lightning conductors or cables to be securely attached both mechanically and electrically to independent, pure copper earth plates or

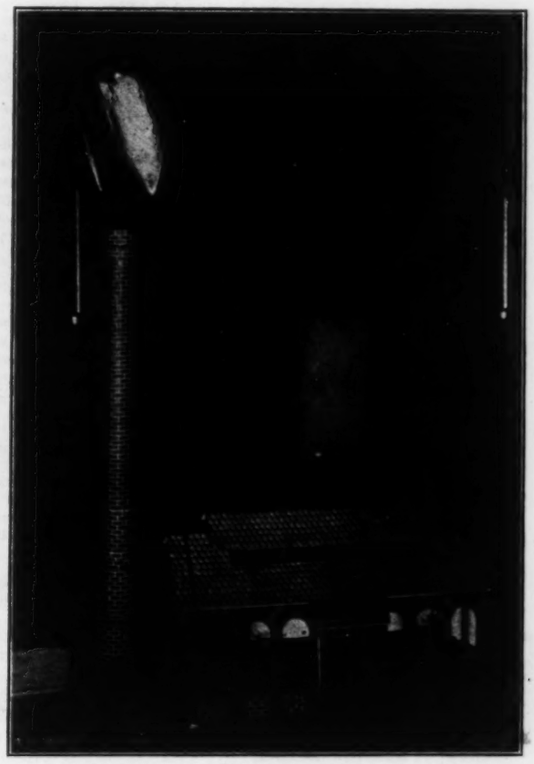
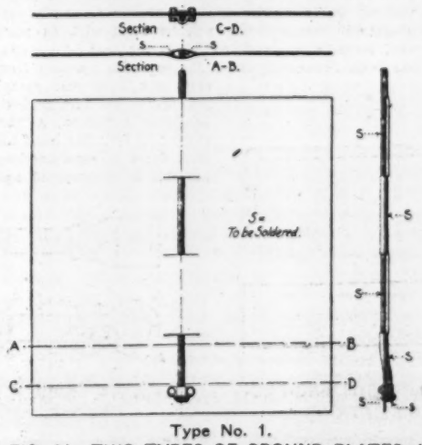


Fig. 8. Brush Discharge from Model Chimney-Protection Device; U. S. Navy Experiments.

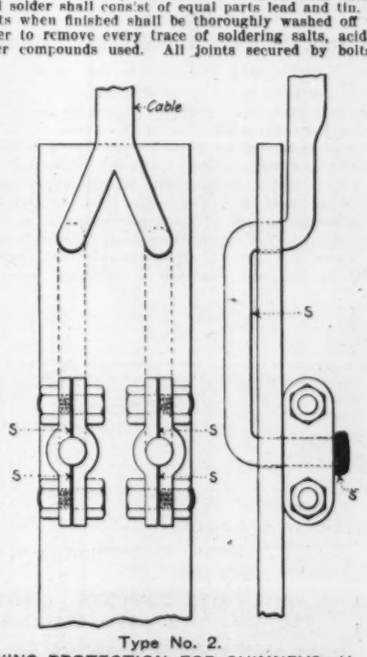
FIG. 9. COMPLETE PROTECTION OF MINIATURE POWER PLANT AGAINST LIGHTNING, MULTIPLE POINT ARRANGEMENT; U. S. NAVY EXPERIMENTS.

bars. In cases where the chimney foundations have already been filled in, instead of earth plates earth terminals may be used, composed of pure copper bars 3 ins. × ½ in. × 3 ft. In all cases the lightning-conductor terminals shall extend to the ground water level, and in no case shall they extend to less than 15 ft. from the ground surface. Earth plates shall consist of pure copper 3 ft. × 3 ft. × ⅛ in.

APPLICATION OF CONDUCTORS TO CHIMNEY.—Each lightning conductor shall be secured to the exterior of the chimney by means of bronze or brass anchors, without the intervention of any insulators or insulating material whatever. The brackets for attaching ring or conductors to chimneys to be of high-grade bronze or brass, composition of same to be submitted for approval, and to be fitted with approved clamps for securely gripping said conductors and making a good electrical connection therewith. The tongues or shanks of the anchors or brackets shall enter the masonry of the chimney a distance of at least 6 ins., and shall be at least



Type No. 1.



Type No. 2.

FIG. 11. TWO TYPES OF GROUND PLATES, LIGHTNING PROTECTION FOR CHIMNEYS; U. S. NAVY, STANDARD SPECIFICATIONS.

¼ in. in thickness by 1 in. wide, terminating in a suitable head or angle, to prevent the anchor from being pulled out of the masonry. Anchors to be attached to conductors at intervals of not over 10 ft., and sweated to the conductors with solder at intervals of 50 ft. Conductors to terminate within 5 ft. of the top of the chimney, and to be connected through the agency of suitable brass or bronze fitting and be soldered to a 1½-in. × ⅛-in. ring of copper attached to the periphery of the chimney by brackets spaced not over 2 ft. apart; said brackets to enter the brickwork a distance of at least 6 ins. and to be of approved design, with a tongue at least 1½ ins. in width and ¼ in. in thickness, with a suitable angle or head to prevent pulling out. All joints in the continuity of said copper ring as well as between the continuity of the ring and conductor or conductors running down to the ground bars or plates, and including the latter, to be scraped bright, and, after making a secure mechanical joint, to be "sweated with solder." Said solder shall consist of equal parts lead and tin. All joints when finished shall be thoroughly washed off with water to remove every trace of soldering salts, acids or other compounds used. All joints secured by bolts or screws to be locknutted. In applying conductors where the chimney is already constructed holes shall be drilled in the brickwork and said anchor brackets and anchors grouted in, the best Portland cement being used.

TERMINAL RODS FOR LIGHTNING CONDUCTORS.—Copper ring shall be connected through the agency of clamps, insuring a good mechanical and electrical joint,

*"Ueber den Blitzschutz auf Sprengstoff-Fabriken insbesondere Nitroglycerin-resp. Dynamit fabriken. Direktor Knight, Dynamitfabrik, Krümmel."

with vertically arranged copper rods, at least ¾-in. diameter and 10 ft. in length. The joints to be "sweated with solder" as before described. Copper rods to be placed equidistant around this ring, and supported in a rigid position vertically, through the agency of additional anchors set in the masonry and a copper spider resting on chimney top as shown in the drawings. Rods to be arranged with a uniform spacing of practically 4 ft. This

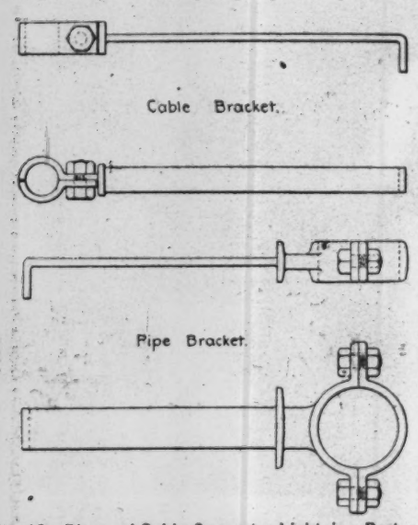


Fig. 12. Pipe and Cable Supports, Lightning Protection for Chimneys; U. S. Navy, Standard Specifications.

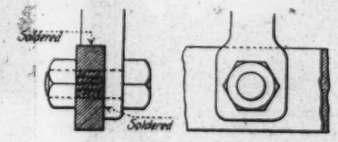
is taken to mean, for example, that ten such vertical rods shall be provided for a chimney of 12 ft. outside diameter of chimney at top.

DISCHARGE POINTS.—Each rod shall terminate in a two-point aigrette, each spur or point of this aigrette to be at least 3¾ ins. long, the bases of which spurs shall be at least ⅜ in. in diameter, tapering to a sharp and well-finished point; said aigrette to be provided with approved means to secure a strong mechanical and electrical joint with the vertical rods heretofore described and to which it is attached. The joints shall be "sweated with solder" as heretofore described.

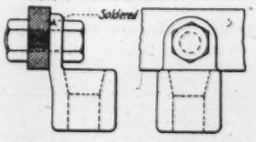
CHIMNEY-BASE PROTECTION.—All lightning conductors shall be enclosed at bottom with a heavy galvanized iron pipe of 1½ ins. diameter, and extending 3 ft. into the soil and 10 ft. above. Said iron pipe to be provided with approved brackets to securely hold it to the chimney; brackets to be not over 3 ft. apart.

INSPECTION.—No scaffolding shall be removed before inspection of the lightning-conductor installation shall have been made by a Government representative.

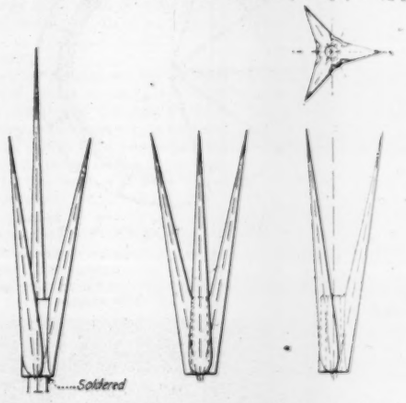
NOTE.—This specification is to be accompanied by a drawing, furnished by the Bureau of Yards and Docks and approved by the same, giving detail parts.



A. Connection of Multiple Tipped Rods to Copper Ring.



C. Attachment of Chimney Conductor to Copper Ring.



B. Pointed Tips for Multiple Tipped Rods to Copper Ring.

FIG. 15. DETAILS OF CHIMNEY TOP LIGHTNING PROTECTION.

THE APPLICATION OF TAR TO MACADAMIZED ROADS.*

By THOMAS AITKEN,† M. Inst. C. E.

The application of tar to macadamized roads has occupied the author's attention for many years, and various methods of applying it have been tried with, generally speaking, beneficial results, but in a manner and at a cost which would not warrant its general introduction. Further consideration of the matter showed that if tar could be applied in the form of a fine spray in re-coating operations, the object aimed at would be attained. By such means the ordinary method of applying water and some form of earthy binding material would be dispensed with, and a practically waterproof

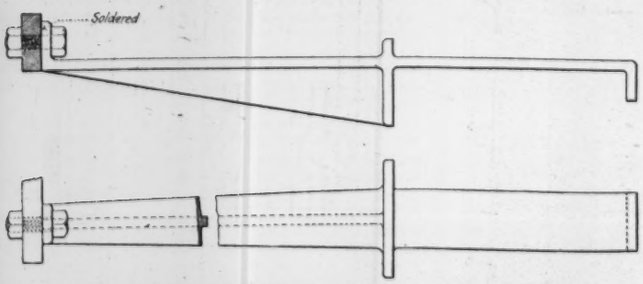


FIG. 13. OUTER RING SUPPORTS. CHIMNEY-TOP LIGHTNING PROTECTION; U. S. NAVY, STANDARD SPECIFICATIONS.

road formed which would reduce mud and dust to a minimum. The results of these experiments, favorable in most particulars, led the author to devise an apparatus for spraying tar, either in a hot or cold state, into the newly spread coating, and so act as a matrix or binder instead of using water and a binding material. This apparatus has been in operation for some considerable time, and satisfies the necessary requirements.

In operating this apparatus it is necessary, in the first place, to pump air into the receiver to a pressure of from 100 to 150 lbs. per sq. in., depending on the viscosity of the tar, before forcing the tar into it from the tank. In order to obtain this pressure it is necessary to travel the vehicle for some time along the road, or it may be accomplished by lifting the wheels clear of the ground and attaching a driving belt to a road-roller or traction engine. Once the necessary pressure is attained it remains constant, and the machine is at all times ready for working, and when the desired pressure is registered, the valve is adjusted so as to pump in tar, or tar and air, from the tank into the receiver. When the latter is about half filled with tar, the pressure will rise to from 200 to 250 lbs. per sq. in., when the apparatus is ready for spraying the tar. The outlet valve may be regulated to give an exceedingly fine spray, or a larger quantity may be applied by opening it to three-quarters or full stock. The supply-regulating valve must be so adjusted that the quantity of tar pumped into the receiver will equal the amount of tar being sprayed on to the road. The metaling is not rolled in the first instance, as in the ordinary system of consolidating the material, the object being to cover all the surfaces of the roadstone with a film of tar previous to consolidation. This is carried out by passing the spraying machine over the loose metal once in either direction, which, combined with the great pressure exerted in forcing the tar through fine spraying nipples, ensures the whole mass of stones, to a depth varying from 3 to 5 ins., being equally treated. The fineness of the spray secures equal distribution, and the pressure forces it well into the metal coating. After a length of from 30 to 50 yds. of full width coating has been sprayed with tar, a light layer of small chips is applied to assist in filling the interstices, especially at the surface. The author, in using 2 to 2¼-in. gage roadstone, finds this necessary to make a solid and homogeneous mass. With roadstones of a smaller size—1-in. gage, for instance—the necessity of applying chips is not essential for efficient consolidation. The main point is to use as little tar as is consistent with proper binding, and to apply chips, if necessary, so that the interstitial vacant spaces will be filled with as much hard material as possible. When the coat of metaling has been thoroughly rolled the spraying machine traverses the road and sprays the surface, one turn generally being sufficient. A thin coating of very fine chips and dust from a stone-breaking machine is then spread uniformly over the surface and finished by further rolling. No sweeping is necessary by this method of construction, therefore a considerable saving is effected in labor and the cost of brooms. Two or three men only, according to the conditions of the work, are required to rake into position or add more metal and apply the chips when necessary. There is seldom any necessity for applying fresh material during rolling operations to make up depressions experienced in the ordinary method of working through the old surface being softened by watering, and the displacing action caused by the [illegible] in sweeping over the roadstones.

The amount of tar necessary to properly [illegible] the roadstones for every [long] ton of metal appl[illegible] varies according to the size of the material used and [illegible] quality of the tar, but from 4 to 6 [Imp.] gals. ma[illegible] considered sufficient under ordinary circumstanc[illegible] This quantity of tar would, therefore, with a 3½-i[illegible] coat of metal, be equal to 0.56-gal. [Imp.] per sq. yd [illegible] 0.67-gal., U. S. measure] of road covered. The init[illegible] cost of making roads by this system is greater tha[illegible] the ordinary method. The material after consolida[illegible] however, becomes a homogeneous mass, and intern[illegible] friction or abrasion is eliminated. The prolongation of [illegible] durability of a road so made will be greater, probably [illegible] doubled, compared with the ordinary method of construc[illegible] consequently ultimate economy will be promoted. [illegible] surface of a tarred road is practically waterproof, [illegible] the elimination of dust and mud, or their reduct[illegible] to a minimum, would alone be sufficient to justify the [illegible] general application of tarred macadam. The cost per [illegible] of carrying out the work in the manner described for consolidating 130 [long] tons of metal each day is [illegible]3.464. [27 cts.] per ton. The additional cost was 6[illegible] to 8d. [12 to 16 cts.] per [long] ton more than ordinary macadam. The hire of two horses is charged for, but in most instances one horse only is required. The cost of spreading the roadstones and chips being the same in either case, it is unnecessary to take these items into account in making a comparison. By the ordinary methods the cost is 7.63d. per [long] ton, or about 61 less than when tar is used. The cost of tarring and rolling a 3½-in. coat of metal is, therefore, 1.5d. per sq. yd. On a road 16 ft. in width the additional cost by using tar would be £26.08 [$127] per mile over the ordinary method when water is obtained free of charge. On a similar road, but using 6 [Imp.] gals. of tar per ton of metal applied, instead of 5 gals., the cost would be £35.16 [$171] per mile more than consolidating macadam in the ordinary way. The amount of water required per [long] ton of metal by the usual methods of consolidation is about 40 [Imp.] gals., and when this has to be paid for the cost may be taken as 2s. 3d. [55 cts.] per day. The cost of tar varies considerably in different localities, but the quality is of the greatest importance, and only the best distilled descriptions should be used. The best form of vehicle for spraying the tar is a motor van having a large tank capacity holding about 800 [Imp.] gals., which would be more than sufficient for one day's work in rolling the roadstone coating.

The results of the method of construction or repairing roads described show that the road during and after the trying climatic conditions of alternating frost and thaw presents a smooth compact surface. The "licking up" of the roadstones by the wheels of vehicles under such conditions on ordinary macadam is very great, and considerable damage is thereby caused. On tar-macadamized roads, however, experience shows that "licking up" does not take place under these circumstances, consequently economy is promoted by the reduced cost of maintenance. The method of washing the tar over the surface or grouting requires from 7 to 9

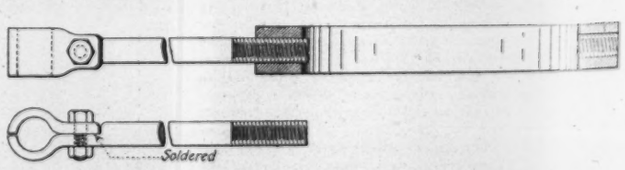


FIG. 14. SPIDER RODS AND INNER RING, CHIMNEY-TOP LIGHTNING PROTECTION; U. S. NAVY, STANDARD SPECIFICATIONS.

*Extract from a paper on "Construction and Maintenance of Roads," read at the Scottish District Meeting of the Association of Municipal and County Engineers, St. Andrews, Scotland, June, 1907.

†County Engineer, Cupar, Fife, Scotland. Mr. Aitken is author of "Road-Making and Maintenance," a valuable British book.

[Imp.] gals. of tar for each [long] ton of roadstones applied. This quantity is, however, excessive, and it may become sticky and troublesome in hot weather, and may lead to the disintegration of the surface. It is essential that the road metal, chips and dust should be in a thoroughly dry state, as moisture militates against good work; therefore rolling operations by this process can only be undertaken in fine weather. The finished surface is like asphalt in appearance, and, while not equal to it in actual wear, has superior properties in some respects. Tar-macadamized roads have a certain amount of resilience, foothold is much better, and it is practically noiseless compared with asphalt pavements.

The reason why tarred macadam, carried out in a proper manner, is free from dust and mud and wears longer than ordinary macadam, is simply because the frictional resistance of the stones is increased to such an extent that internal motion and rubbing are prevented, and the tar and chips would fill the interstices of the metal coating, prevent percolation of water and the evils resulting from that cause. Tar, no doubt, might be improved by the addition of a bituminous material, which would further increase the life of a road, but, of course, at additional cost. This fairly represents the possibilities of this form of construction or tar-macadamizing.

WATER LEVEL GAGES.

By ROBERT E. HORTON,* Assoc. M. Am. Soc. C. E.

In connection with work as Engineer, U. S. Geological Survey, during the years 1900 to 1906, the writer designed the several styles of simple river gages illustrated in the accompanying figures. The object in view was to secure gages that would be efficient and inexpensive and at the same time convenient of erection and permanent when placed in streams subject to the action of ice, floating logs and debris.

Painted board gages hitherto commonly used are short-lived; the paint soon wears off from the portion most used, generally the lower portion, rendering the gage illegible. To repair this defect, the gage must usually be removed or replaced by a new one, for it can only be repainted in place down to the water line. It thus happens when such gages are used that the record for the lowest and often most important stages of streams is lost, or only obtained in an inaccurate manner. The use of notches, burned marks, brass tacks or hoop staples for division marks has been tried with indifferent success. In many cases these gages are used in places remote or difficult of access, and if a gage is lost or torn from an abutment during high water, important records may be lost.

The staff gage, shown in Fig. 1, was devised to meet these conditions. It consists of a 2 × 8-in. cypress plank, reinforced by wire spikes driven in the edges. The division marks are wrought-iron staples, handled by jobbers under the name "wagon-bow staples." They can be had in quantities specially galvanized, at a cost of 1 to 1½ cts. each. The lengths used are 2-in. staples for even foot and half-foot marks, and 1½-in. staples for intermediate divisions.

The gage is usually constructed in the field, the base board being laid off with a steel tape and try square. Holes are bored for the staple tangs with a ⅜-in. wood drill. Hard brass figures are attached by long wire nails and the nails and staple tangs are clinched on the back of the board. Gages of this construction, that have been in use in the mining and lumber regions of Michigan for several years, are still plainly legible and accurate, although a considerable depth of wood has been cut away between the staples by the wear of logs and ice and in chopping ice away from the gage with a blunt axe. This style of gage, having a raised graduation, is more legible at a distance than any style of flat surface gage that the writer has seen.

The gages shown in Figs. 2 and 3 are constructed from strips of No. 12 sheet steel, 4 ins. wide, covered with six coats of hard enamel. The gage shown in Fig. 3 is usually made in 5-ft. sections, and is divided to feet and tenths. By placing sections end to end on a base plank, as shown, and attaching brass figures at the side, a gage of any length can easily be built up. The style of enameled section shown in Fig. 2 is especially adapted for use in connection with weirs. It is usually made in lengths of 2 ft., graduated to hundredths of a foot, with figures denoting each five-hundredth. Gages longer than 2 ft. are built up in the same manner as for the gage shown in Fig. 3. These enameled gages will not withstand sudden blows, but when placed in protected places they are extremely durable, and an injured section can be readily replaced. When made in quantities, and kept in stock, their cost, including erection and maintenance, is probably smaller than for any other type of permanent staff gage.

There are many situations where a staff gage cannot be placed in a permanent or accessible position, or where if used it must be in sections more or less widely separated, to include both the low water and flood stages of a stream. In many such cases, in deep canyons crossed by bridges, or reservoirs with sloping banks or other locations, a gage of the plumb-bob type is preferable to a staff gage.

Such gages, as commonly constructed, comprise a long graduated scale, usually contained in a triangular box, attached to the guard rail or hand rail of a bridge, together with a weight or plumb-bob suspended from one end of a chain. The scale usually has a length equal to the range of rise and fall of the stream. In reading the gage the weight is dropped until it touches the water surface and the reading is taken by noting the position, alongside the scale, of a marker placed at or near the end of the chain. In spite of the simplicity and common use of such gages, there are several objectionable features inherent in their construction. The chain is usually passed over a pulley, involving a correction for the length of the quadrant of the arc. Heavy bronzed sash chain, which is apparently the best chain available for this purpose, is liable to kink and stretch. In such cases chains used in such gages have progressively stretched several inches in the course of two or three years. This defect can be partly but not wholly remedied by proper stretching of the chain at the start, although the length of the chain usually increases with wear. Such gages require frequent inspection and checking. In reading the gage, the observer is often obliged to lean over the bridge in an awkward or dangerous position, in order to note the position of the plumb-bob and at the same time hold the chain in position and read the gage. The gage box is long and awkward in shape and not easily protected from the weather.

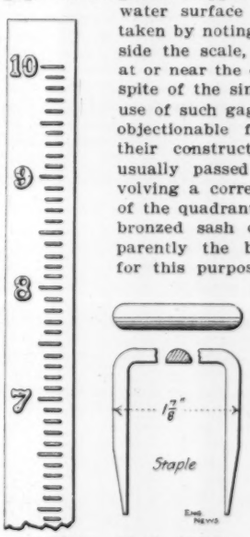


Fig. 1. Plank Water Level Gage with Divisions Made of Wire Staples.

Fig. 4, reproduced from a patent drawing, shows a special form of plumb-bob or weight and tape gage,* designed by the writer with a view to securing a compact and convenient substitute for the various styles of plumb-bob gages hitherto used by various federal and state bureaus. This gage shown is contained in an oak box 20 ins. sq., armored with heavy galvanized iron, the doors being miter-hinged so as to swing back flat against the sides. Instead of a chain, a thick narrow phosphor-bronze tape is used and is wound on a reel attached to an aluminum back or brake spider. The tape is graduated in even feet with the zero end secured to the reel. The tape runs opposite an enameled steel scale 1 ft. long, which is graduated to hundredths of a foot. This scale is adjustable vertically and bears an extension bar protruding slightly above the top of the box and covered by a cast-iron cap. By removing this cap and holding a leveling rod on top of the extension bar, the elevation of the zero of the enameled scale can be determined easily and accurately. In taking an observation, the spring brake is released, allowing the gage weight to fall slowly to the water surface. If desired, the weight and tape can be held in position by the brake permitting the observer to step to one side and note the position of the weight relative to the water surface. When properly adjusted the reading is taken by recording as units the number on the tape that stands opposite some part of the enameled scale, and adding as a decimal the corresponding reading on the scale.

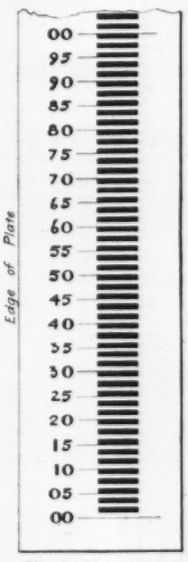


Fig. 2. Sheet Steel Gage with Decimal Divisions.

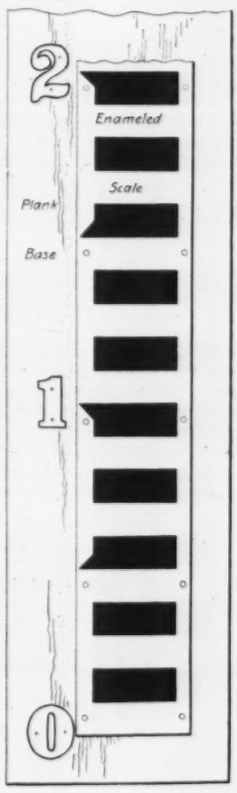


Fig. 3. Sheet Steel Water Level Gage.

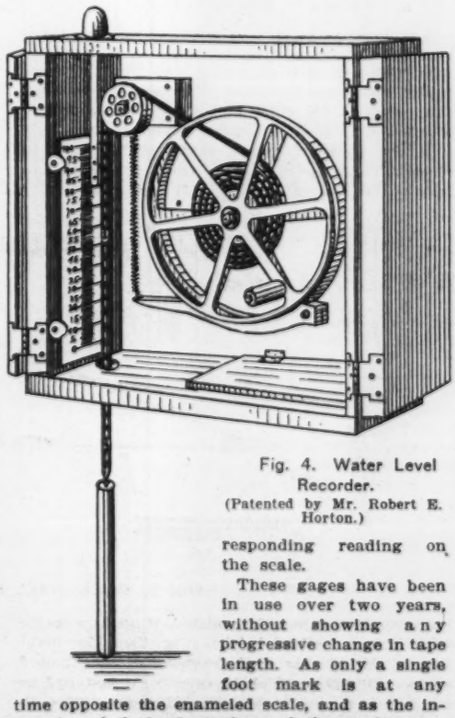


Fig. 4. Water Level Recorder.
(Patented by Mr. Robert E. Horton.)

These gages have been in use over two years, without showing any progressive change in tape length. As only a single foot mark is at any time opposite the enameled scale, and as the integral and decimal portions of the reading are distinct, the chances of error in reading and

*Hydraulic Engineer, 481 Hudson av., Albany, N. Y.

*Daniel L. Mott, 20 Arcade, Utica, N. Y., Manufacturer.

recording are found to be small, and it appears that with smooth water readings can be obtained accurately to the nearest hundredth foot by an unskilled observer, such as is commonly employed. These gages are fitted with locks using the standard key now in use on most box gages of the U. S. Weather Bureau, U. S. Geological Survey and the Barge Canal Department of New York State.

A modification for use on high bridges, where it is difficult to observe the weight at the water surface, consists in the addition of an electrical attachment whereby a buzzer is sounded whenever the weight touches the water; with this device, fairly accurate readings can be taken from very high bridges, or over somewhat disturbed or choppy water.

DOCK WALLS AT THE PORT OF KOENIGSBERG, PRUSSIA.

In the course of the work of reconstructing the inner port of the city of Königsberg it was necessary to rebuild many miles of collapsed dock walls. According as the docks were designed for river vessels or for sea vessels, the walls were reconstructed according to one of the two following types: Wherever sea vessels were supposed to dock, the walls were founded on rows of piles (shown at P in Fig. 1) inclined and criss-crossed

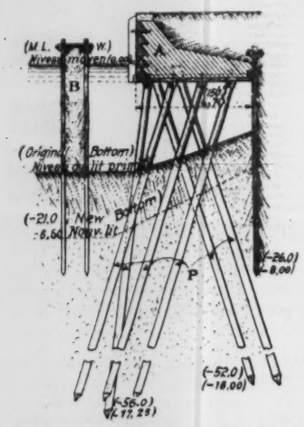


Fig. 1. Section Through Dock Wall for Sea-Going Vessels at Koenigsberg, Prussia.

and from 56 to 62 ft. long, on the heads of which was constructed a massive wall, A, of concrete with a facing of hard bricks. In front of these walls, which were protected in construction by a cofferdam, B, the river bottom was excavated to a depth of 21 ft. below mean water.

In the parts of the river accessible only to river or canal boats, and in which the depth had only to be maintained at 13 ft., the walls were built much lighter and consisted of an iron frame with a face wall of bricks (Fig. 2). The main frames, M, of this steel framework were bolted on iron channels which in turn were fastened to the top of a row of tongue and groove piles, P, in such a manner as to make rectangular panels with a top chord also of channels. Afterwards these panels were filled with a masonry construction of cemented bricks forming a wall increasing in thickness from 5 ins. at the top to 10 ins. at the bottom. To give stability to these walls and to provide resistance for the thrust of the earth, the upper part of the piles, P, and the verticals, M, in the iron framework were held back by tie rods R, S, T, furnished with turnbuckles, and tied into a second row of piles, P', driven back of the first row and acting as anchorages.

This second row of piles, also tongue and groove, were driven to ground-water level and their connection with the tie rods was insured by cross-beams shown in Fig. 2. The construction of the light walls presented a great many difficulties on account of the poor quality of the metal in the tie rods and turnbuckles. The high percentage of phosphorous rendered the rods very brittle and in tightening the turnbuckles rupture often occurred through the thread. However, the later rods were of better material and the wall is now serving its purpose.

The foregoing information and illustrations were taken from "Le Génie Civil," which in turn acknowledged its indebtedness to the "Zentralblatt der Bauverwaltung."

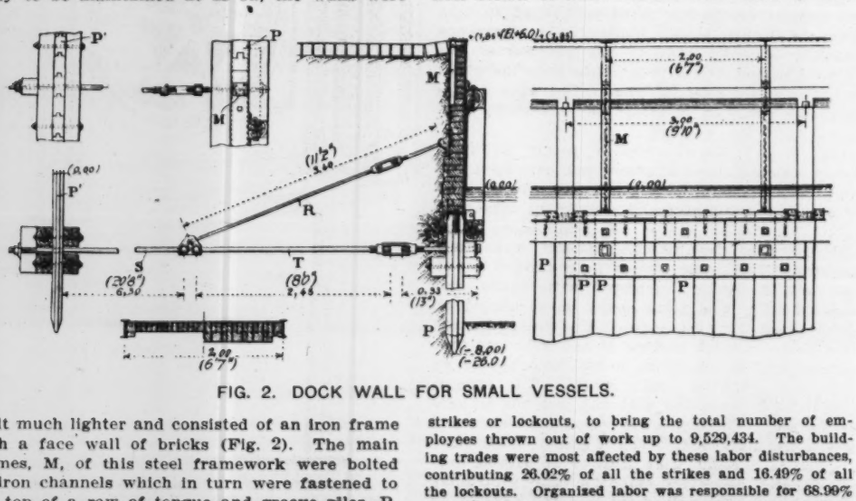


FIG. 2. DOCK WALL FOR SMALL VESSELS.

THE CAPE COD CANAL has at last been started, 210 years after the project was first suggested. In 1697 the General Court of Massachusetts ordered an inspection to be made of the proposed location and at odd times through the following two centuries many surveys and reports have been made on the work. The present route of the canal is from Sandwich in Massachusetts Bay through Bournedale and Bourne to Buzzards Bay. The first shovelful of dirt was thrown out on Aug. 20 at Sagamore, Mass., by Mr. Wm. Barclay Parsons, M. Am. Soc. C. E., of New York City. In our issue of Dec. 20, 1906, p. 669, we published a short historical account of the various investigations of the project.

A NEW DESIGN OF SLEEPING CAR, in which the upper berths are formed by swinging up the backs of the seats, thus leaving the upper part of the car unobstructed during the day, is being introduced on the Texas Central Ry. The partitions between the berths drop into recesses in the backs of the seats. The arrangement of the seats is very similar to that of a Pullman car. The special advantages claimed for the new car are roominess, appearance and convenience, and also a reduction of weight of about 15% as compared with Pullman cars. The new 60-ft. cars on six-wheel trucks weigh 45 tons. The patents are owned by the National Sleeping Car Co., and the cars were built by the American Car & Foundry Co., at its shops at St. Charles, Ill.

STRIKES AND LOCKOUTS IN THE UNITED STATES for the 25-year period 1881-1905, are reported on at length in the Annual Report of the Bureau of Labor, Department of Commerce and Labor, for the year 1905. During the 25 years named, there were 36,757 strikes and 1,546 lockouts, affecting 181,407 and 18,547 establishments, respectively. A total of 6,728,048 persons struck and 716,231 were locked out. In addition, a sufficient number of other workmen was affected by either strikes or lockouts, to bring the total number of employees thrown out of work up to 9,529,434. The building trades were most affected by these labor disturbances, contributing 26.02% of all the strikes and 16.49% of all the lockouts. Organized labor was responsible for 68.99% of all the strikes reported during the 25 years, and these strikes involved 79.69% of all the strikers during that period. The strikers won their demands in 47.94% of the strikes and were partly successful in 15.28%. Employers won in 57.2% of the lockouts and were partly successful in 10.71%. A demand for increase of wages was the cause of 32.24% of all the strikes, and a partial cause of 8.48% additional. Reductions of wages caused an additional 11.9% of the strikes. Of all the strikes were sympathetic. Strike and lockout settlements by either joint agreement of the parties concerned, or by arbitration, seem to be coming into vogue. For the five-year period ending with 1905, 5.7% of all strikes and 12.2% of all lockouts were settled by joint agreement, and 1.6% of the strikes and 2.03% of the lockouts by arbitration. The report states that these figures do not fully represent the progress being made in the settlement of disputes, as both of them are being brought into play to a large and increasing extent to settle disputes before the stoppage of work occurs.

A SCHOOL OF SAFETY FOR MINE FOREMEN is the latest advance made by the Delaware, Lackawanna & Western R. R., upon the principle that prompt and effective application of state laws and its own rules will be the best preventive of accidents in its anthracite coal mines. As such rules and laws, unless frequently discussed, are apt to be soon forgotten, the road has instituted a plan to hold competitive examinations every six months concerning the details of regulations. State mining laws and company rules must be on the tongue's end of every mine foreman, fire boss, barn boss or driver boss employed in the mines.

The company's collieries have been divided into four districts, each under a superintendent and assistant. The districts each average about five collieries, and examinations in each district will be carried out separately.

An Examining Board, consisting of the General Manager, his assistant, and the Chief Engineer, will examine the men in a hall especially engaged for the purpose. After all examinations have been completed the answers, recorded by a stenographer, will be carefully gone over and receive marks of relative merit. To the district showing the highest average for all men examined will be awarded a trophy, which will be retained by the district until the next examination. If any district wins the trophy three times in succession it may retain it permanently.

Mine foremen and assistant foremen are examined by boards appointed by the state, before receiving certificates which permit them to hold their positions. The examinations conducted by the company are intended to supplement those prescribed by the state.

STORAGE BATTERY MOTOR-CARS for passenger service have been placed in operation by the Prussian States Railways, Germany, for the short runs from Mainz to Oppenheim (about 12.5 mi.), to Ingelheim (11 mi.) and to Rüsselheim (7.5 mi.). The cars are about 40 ft. long, with six third-class compartments, each seating ten persons. Under each of the twelve seats is a compartment, for 15 storage cells, carefully partitioned and equipped with ventilating ducts leading to the open air. At each end of the car is a controller compartment, about 5 × 4 ft. inside, whose floor is elevated above the floor level of the car by slightly more than 3 ft. This contains all the motor and brake control apparatus and the battery, lighting and signal lamp switches. The compartment is reached by a flight of six steps on the outside of the car. The car-body is supported by three axles about 10½ ft. apart. Each end axle carries one motor of 25 HP. The weight of the car loaded with passengers is about 42 tons. The storage cells have 200 amp.hr. capacity, with a weight of 121 lbs. each. The entire battery weighs about 22,000 lbs. and has a capacity of 68.5 KW. hrs. Each cell measures about 5 ins. wide × 13 ins. long x 17½ ins. high, and carries five negative and four positive plates.

As the battery is exhausted after a 37-mi. run and must necessarily be charged at Mainz, only a single round trip could be made to Oppenheim or Ingelheim, although two round trips could be made to Rüsselheim. By combining one of the longer trips with the shorter, the entire battery charge would be more nearly utilized and the cells would be in better shape for recharging.

The mean schedule speeds on the three lines are about 19, 20 and 23 mi. per hour, with a maximum running speed of about 28 mi. per hr. The storage cells are of the type made by the Akkumulatoren-Fabrik Co. The other electrical equipment was furnished by Siemens-Schuckert Co.

LIGHT LOCOMOTIVES hauling trains of light cars are on some European railways preferred to motor-cars now being extensively used for operating auxiliary local traffic on main lines. In most cases these are small side-tank locomotives of the 0-4-0 class, but the Austrian State Railways have recently put in service two special engines of the 2-2-2 class, built by Kraus & Co., of Linz, Germany. The leading axle is under the smoke-box, forward of the outside cylinder, and the driving axle is close against the firebox. Just behind this is the radial trailing axle (under the rear coal bunker). The engine is a two-cylinder compound on the Goldorf sys-

tem; the low-pressure cylinder takes superheated steam, the steam from the high-pressure cylinder being passed through a superheater. On trial runs, four four-wheeled cars weighing 44 tons were hauled at a speed of 38½ miles per hour on a 1% grade 8 miles long. On easier grades a speed of 64 miles per hour was attained. The engines have the Walschaert valve gear, side tanks, and peculiar spark-arresters placed on top of the smoke-stacks. The principal dimensions are as follows:

Driving wheels (2)	4.75 ft.
Wheelbase (12.5 + 5.1 ft.)	17.60 ft.
Weight on leading axle	5 tons
On driving axle	73½ tons
On trailing axle	34¼ tons
Total, loaded	161½ tons
Total, light	12 tons
Cylinders (2)	10.4 × 22 ins. and 16 × 22 ins.
Heating surface, tubes	462.68 sq. ft.
Firebox	56.00 sq. ft.
Total	518.68 sq. ft.
Superheating surface	35.50 sq. ft.
Grate area	10.76 sq. ft.
Tubes: 130; diam., 1.64 ins.; length	4.92 ft
Superheating tubes; (16); diam. outside	1.33 ins.
Water	106 cu. ft.
Coal	60 cu. ft.

BLOCK SIGNALS are required to be installed by all railways in Indiana which have earnings in excess of $7,500 per mile. This is an order recently issued by the Railway Commission of Indiana. The railways must consult with the engineer of the Commission as to the systems to be adopted, and the equipment must be completed by July, 1909.

FREIGHT TRAINS FOR HIGHWAY HAULAGE, as a development of ordinary traction engine service, have been tried at various times in this country and abroad. One system of this kind has recently been introduced in England, and another is now in use in Germany, being operated on roads near Spandau. In this latter system a steam locomotive is employed, hauling two-wheeled wagons, and by means of special couplings and steering mechanism the train can pass curves as sharp as 23 ft. radius, and can be driven forward or backward on curves as well as on tangents. The wagons have wheels 63 ins. diameter, with ball bearings and 6-in. tires. The 30-HP. engine burns oil fuel, and can carry a supply sufficient for 50 miles run. It is said to be capable of hauling a load of 20 tons on a level road at a speed of five miles an hour. The fuel consumption is given as averaging 0.22-gal. per HP.-hr., with a consumption of 2 to 3 gals. of water per HP.-hr.

ANOMALOUS EXTENSIBILITY OF CONCRETE when reinforced has again been studied experimentally by Prof. C. Bach, of Stuttgart. The assertion of A. Considère, that concrete when reinforced is capable of undergoing without rupture elongations many times as great as the ultimate elongation of plain concrete, was attacked experimentally and disproven simultaneously in America and in Germany. Prof. F. E. Turneaure and Prof. A. N. Talbot, independently in this country, and Mr. Kleinlogel in Germany, showed that the assertion is untenable. Experiments made in the Royal Testing Institution at Berlin showed even a slightly lower rupture-elongation for reinforced than for plain concrete. On the other hand, Considère in a check series of tests found reason to reaffirm his "law," and Prof. Schüle, of Zürich, also supported it. Prof. Bach therefore believed that further experiments were justified. The "waterline" method of Prof. Turneaure (also used by Kleinlogel and by Feret) was used to give a test of when local disintegration appeared; and, as Prof. Bach rightly argues, such disintegration in the tension side of a beam represents the tension failure of the concrete, since the smallest crack forming in a tension test-piece would immediately cause shifting and concentration of stress, bringing about instant rupture. The results showed the following unit elongations:

5 plain tension specimens	0.000065—.000090
68 plain and reinf. beams	.000080—.000100
4 plain tension specimens	.000080—.000100
21 reinforced beams	.000090—.000100

These figures, in the case of the beams, are not by any means identical with the elongations at which the first crack could be detected, but are elongations at which water spots on the tension face appeared. The first perceptible crack appeared at .000080 to 0.000125 for plain beams, and 0.000100 to 0.000367 for reinforced beams. The last-named value, which is about four times as great as the elongation at the first water spot, was obtained from a beam reinforced with a slotted sheet of metal, adapted to give maximum distribution of steel in the concrete. There is a large difference in elongation at first crack, between a beam seasoned in air and one seasoned in water, the contraction of the concrete in the first case causing an initial tension which leads to earlier cracking. Thus, of four identical beams, two were seasoned in air and two in water; the former began cracking at 0.000097, while the water-seasoned beams averaged 0.000205. Prof. Bach concludes: "Concrete in itself has the same extensibility when reinforced as when not reinforced." The development of actual cracks, of course, may be retarded by various causes until a considerably greater elongation is reached than corresponds to the appearance of water spots, but the cracks are not the true criterion of tension failure. The results of Prof. Bach's experiments are given by him in the "Zeitschrift des Vereines Deutscher Ingenieure" of June 29, 1907.

THE FRICTION OF HYDRAULIC CUP PACKINGS was studied by Prof. A. Martens, with special reference to hydraulic testing-machines. The large hydraulic machines in the Royal Testing Bureau at Berlin (Gross-Lichterfelde) are all fitted with lever weighing apparatus to measure the load, and the hydraulic cylinder serves only for straining, i. e., applying the load. This made it easy to determine the friction of the packings, by subtracting the weighed load from the product of water-pressure and plunger-area. In the five machines in question, the packings were set very tight, tight enough in fact to prevent even the slightest leakage. Yet the friction values determined were relatively low. Running empty, the three machines that have uncounter-balanced rams showed a friction of 6% to 16% of the applied hydraulic pressure, while two machines with partially counter-balanced rams showed a friction of 22% to 43%. The latter, however, have two packings, one at either end of the cylinder, so that the friction per packing is half these amounts, or 11% to 22%. At a pressure of 50 atmospheres, the five machines ranged from 2% to 5% friction loss per packing (i. e. half the total loss in the case of the two machines which have two packings); at 100 atmospheres the losses were 1.8% to 3%, and at 200 atmospheres 1 to 1.6% per packing. The individual values of any series of tests of a given machine at a given pressure showed a very small range of variation, indicating that the friction conditions remained very uniform. Prof. Martens concludes from his experiments (Zeitschrift des Vereines deutscher Ingenieure, July 27, 1907) that the measurement of loads in a hydraulic testing-machine by gage-readings of the operating pressure involves errors no larger than 2½% to 5%. Further, the friction values, if once observed, may be applied as corrections to the pressures measured in subsequent test with an extremely small probable error (100 to 200 lbs. total in the 50 and 100-ton machines tested), so long as the condition of the packings does not change appreciably. Leathers that are once worn into service should not change greatly in friction even during long periods.

FUEL TESTING AT NORFOLK, VA., by the Technologic Branch of the U. S. Geological Survey covers a remarkably wide program. In the tests of coal, it is planned to determine the influence of size of coal, method of stoking or feeding, rate of combustion, and ratio of heating surface to grate-surface. For this work a 250-HP. Babcock & Wilcox boiler with superheater and Roney stoker has been added to the two Heine boilers brought from the St. Louis plant, and the latter have been re-baffled, and one of them fitted with a Jones underfeed stoker. Induced draft apparatus has been provided for all three. This plant also is to serve for further experiments in determining furnace efficiency. Studies of the destructive distillation of coal will be undertaken in several divisions, partly from the standpoint of physical chemistry. Finally, coal briquettes in quantity will be manufactured, a new German machine having been added to the previous equipment, and these briquettes will be tested on war vessels under the direction of the steam engineering division. The gas-producer equipment has been modified slightly, and incidentally the gas purifying apparatus used at St. Louis has been removed, as experience showed that the danger from impurities is small. Tests will deal with: Proper length of test runs, influence of size of coal, best depth of fuel bed, effect of rapid load-variations, performance of different fuels, etc. In the field of alcohol and gasoline, the first work will be on carbureters, to investigate vaporizing performance, and subsequently comparative tests of gasoline and alcohol will be made. The utilization of kerosene is also to be studied. More or less apart from the general line of the fuel test work are several other investigations. Studies of spontaneous combustion of stored coal, with a view to simplifying its prevention, and study of the subject of explosions in coal mines, are among these.

THE AVONMOUTH DOCK for the city of Bristol, England, is an addition to the dock facilities at the mouth of the Avon, seven miles below the city. The new dock, which is now approaching completion, is known as the Royal Edward basin. It is 1,120 × 1,000 ft., with an entrance lock 100 ft. wide and 875 ft. long, having three pair of steel gates. Extending from the lock are two masonry piers or jetties 900 ft. and 1,200 ft. long, each with a lighthouse at the end. The depth of water on the lock sills at high tide will be from 36 ft. at neap tides to 46 ft. at spring tides. At the opposite end of the basin is a branch 500 × 250 ft., from which a lock 85 ft. wide connects with the existing dock or basin. This is closed by a rolling gate which is withdrawn into a chamber at right angles with the lock when communication is to be opened. A 900-ft. dry dock is also connected with the new basin, and provision is made for two branches or slips 1,800 × 300 ft. The walls are of concrete, faced with blue brick. Around the dock are two two-story warehouses 500 ft. long, a one-story warehouse 450 ft. long, and a large grain elevator with receiving conveyors running in a tunnel to the side of the dock. The conveyors for delivering grain to ships will be carried on overhead structures. There will be a number of freight-handling hydraulic cranes of 2 to 10 tons capacity. The work is being done under the direction of Mr. W. W. Squire, City Dock Engineer, and John Aird & Co. are the contractors.

A CURIOUS INSTABILITY IN TURBINES was found in the course of tests made for the turbine-building firm of Briegleb, Hansen & Co., of Gotha, Germany, according to an article on "High-Speed Turbines" by V. Graf and D. Thoma in the "Zeitschrift des Vereins Deutscher Ingenieure," of June 29. When a turbine of 16-in. inlet opening, and fitted with Fink gates, was being tested, the fact appeared that, for a given head, given gate-opening and given speed, two different values of brake horse-power could be obtained. The power curve for varying speed, with fixed gate-opening and head, is a double curve, the difference between the two amounting to some 3%. This phenomenon was noticed first at 0.9 gate-opening, but was found to occur generally at large gate-openings. The discharge or water consumption gave a similar double curve; the efficiency curve, though also double, had its two parts nearly coincident. At lower gate-openings the effect was less marked, and at 0.6 gate there were no longer two full curves (that is, for a given speed two powers were no longer obtained), but the power curve was discontinuous; the points plotted for low and for very high speeds clearly belonged to a different curve than the points plotted for the region of medium speed, the latter curve being the higher. The authors of the article quoted state that somewhat analogous conditions appear in tests of a Samson turbine tested in Germany, which when tested under fixed head and fixed gate-opening, to determine the variation of power output, discharge and efficiency with varying speed, showed a discontinuity in all three curves at a particular speed, beyond which the plotted points represented a distinct curve lying well below the first or main curve. The authors attribute the effect to a sudden change in the internal losses, rather than to a change in the manner of stream flow through the turbine. They assume that, with the same general course of flow, two different conditions of eddying may exist in the turbine, each of which is substantially stable.

CHAIN DRIVES WITH MULTIPLE-SPEED CONE sprockets, are being used by the Morse Chain Co., Ithaca, N. Y., with success. The chain is of the Morse toothed type, engaging the outer surface of wide-face sprocket wheels cut like an ordinary gear. The several wheels which are grouped to make a cone have each, on the side adjoining the next smaller wheel, a sharply tapered hub, which makes the transition between the two wheels. Inserted in this hub and in the gear wheel itself is a series of radially projecting steel blades, each extending across the entire face of the wheel, and on line with a tooth (this tooth being in fact cut from the metal of the blade). These blades, of which usually three are used, extend down along the tapered hub, parallel with the surface of the hub, but projecting somewhat from this surface so as to make this hub virtually a three-toothed sprocket. The chain running on the set of cone-sprockets is shifted from step to step as easily as a belt. By pressing against the side of the on-coming part of the chain, it is slipped sidewise on the sprocket, and as soon as disengaged from the teeth, it engages the three blade teeth of the taper hub. Slipping down this, it readily engages the teeth of the next sprocket below, as the three blade-teeth respectively coincide with three teeth of this sprocket (for this purpose the sprockets have numbers of teeth which are multiples of 3, which requirement governs the relative diameters of the cone steps). The chain, of course, is slack during this operation, at least after it is fully disengaged from the large sprocket. It is then necessary to shift the chain on the other cone of the pair, to the next larger sprocket. This operation is similar to that described. The on-coming part of the chain is shifted toward the next larger sprocket, by pressing against it with the hand or with a belt-shifter. As soon as its teeth engage the three teeth of the taper hub, the chain quickly works up the slope, which is made possible by the fact that the chain is slack. The widening distance between the steel guide-teeth will probably cause the chain to jump a tooth on the slack side, the drive being carried on the other of the two teeth in action. As soon as the edge of the next larger sprocket is reached, the chain is ready to engage at the points where the guide-teeth are, since these continue as teeth of the sprocket, and full engagement is rapidly reached. This curious drive is well described and illustrated in the "American Machinist," of July 18. It is stated that the Morse Chain Co. is running six boring mills and a No. 1 milling machine whose main drive is of the cone-sprocket type here described.

PERSONALS.

Mr. G. G. Hare has succeeded Mr. T. W. Nash as Chief Engineer of the Kingston & Pembroke Ry., Ontario.

Mr. G. A. Baker succeeds Mr. T. J. Tonge as Superintendent of Motive Power of the Santa Fe Central Ry., with headquarters at Estancia, N. M.

Mr. F. H. McGuigan has resigned as First Vice-President of the Great Northern Ry. He was formerly Fourth Vice-President of the Grand Trunk System.

Mr. Byron Layton has resigned as Signal Engineer of the Chicago, Indiana & Southern Ry. He is succeeded by Mr. L. Slattery, with offices at Gibson, Ind.

Messrs. R. B. Watson, M. Am. Inst. M. E., and Wm. Watson have opened consulting offices at 25 Broad St., New York City, for mining examination practice.

Mr. A. E. Hess has resigned as Chief Engineer of the Georgia & Florida Ry. system, and will become associated with the Pensacola, Alabama & Tennessee R. R.

Mr. Robert S. Oliver, M. Am. Inst. M. E., of Salt Lake City, has been appointed successor to Mr. A. J. Orem, late Superintendent of the Red Wing mine at Bingham, Utah.

Mr. H. M. Wells has resigned as President of the Utah Independent Telephone Co., and Mr. H. T. Grant, President of Heber J. Grant & Co., has been elected to succeed him.

Mr. E. T. Richards has resigned as Superintendent of the Newburgh (N. Y.) Light, Heat & Power Co., to accept the superintendency of a similar company in New Orleans, La.

Mr. C. W. Humphrey, Assoc. M. Am. Inst. E. E., former General Manager of the Northern Colorado Power Co., has opened consulting offices in The Rookery Building, Chicago.

Mr. W. J. Bergen has been promoted from Chief Supervisor of Track with the New York, Chicago & St. Louis R. R. to the position of Assistant to the Chief Engineer, with offices at Cleveland. He is succeeded by Mr. C. B. Hoyt.

Mr. Geo. A. Stanion, formerly with the Brooklyn (N. Y.) Rapid Transit Co., has been appointed Superintendent of the new plant of the Lake Shore Engine Works, at Marquette, Mich.

Mr. L. H. Ray, formerly with the Winnebago Traction Co., of Oshkosh, Wis., has been appointed Superintendent of the Sterling, Dixon & Eastern Electric R. R. with offices at Sterling, Ill.

Mr. W. J. Bergen, Superintendent of Track Maintenance for the New York, Chicago, & St. Louis R. R., has been appointed Assistant to the Chief Engineer. Mr. C. B. Hoyt succeeds him.

Mr. Caleb Mills Saville, M. Am. Soc. C. E., of Boston, has been appointed Consulting Engineer by the Isthmian Canal Commission and will be assigned in the near future to work on the Isthmus.

Mr. Donald G. Forbes, M. Am. Inst. M. E., late Manager of the Silver Cup Mine in the Lardeau District, British Columbia, and formerly of Shillingstone, England, is now Consulting Engineer of the Similkameen Mining & Smelting Co., of British Columbia.

Mr. Isham Randolph, M. Am. Soc. C. E., Consulting Engineer, whose resignation from the position of Chief Engineer of the Chicago Drainage Board was recently noted, has opened an office in the American Trust & Savings Bank Building, at Chicago.

Mr. C. G. Delo succeeds Mr. W. B. Causey, whose promotion we noted on Aug. 1, as Engineer of Maintenance of Way with the Chicago & Alton Ry., at Bloomington, Ill. Mr. Delo formerly held the corresponding position with that road at Kansas City, Mo.

Mr. C. T Dike, Resident Engineer for the Chicago & Northwestern Ry. at Pierre, S. Dak., who has been in charge of the construction of the Pierre-Rapid City & Northwestern division, has been made Superintendent of that division with offices at Pierre.

Mr. E. C. Bradley, formerly Assistant to the Assistant to the President of the American Telephone & Telegraph Co., at Boston, has been elected Third Vice-President and General Manager of the Pacific States Telephone & Telegraph Co. with offices at San Francisco.

Mr. G. D. Fowle, heretofore Signal Engineer for the Northern Central Ry. and the Pennsylvania, the Philadelphia, Baltimore & Washington, and the West Jersey & Seashore Railroads, has been made Consulting Engineer, his former position being filled by Mr. A. H. Rudd, former Assistant Signal Engineer.

Mr. Wm. A. Howell has been appointed Engineer of the Street Department of Newark, N. J., succeeding the late Louis C. Dittler. Mr. Howell was formerly Principal Assistant Engineer. Mr. Chas. A. Stilger was promoted from the position of Engineer of Construction to that of Principal Assistant Engineer.

Mr. H. W. Oliver, Assistant to the Engineer of Construction of the Louisville & Nashville R. R., was recently appointed Secretary and Treasurer of the Virginia & Southwestern Ry. and of the Virginia Iron, Coal & Coke Co. He is succeeded with the former road by Mr. E. L. Trowbridge, with offices at Louisville.

Mr. Edward Schildhauer of the Isthmian Canal Commission, Washington, D. C., has been transferred to the Isthmus; he has been attached to the Washington office as Consulting Engineer. Mr. Schildhauer has spent the last half-year visiting the principal locks and dams in this country and will be assigned especially on the Isthmus to the construction of the gates of the locks.

Mr. T. B. Jones, Assoc. M. Am. Inst. E. E., formerly in charge of the Traffic Department of the New Jersey Division of the New York & New Jersey Telephone Co., and later illuminating engineer with the Nernst Lamp Co., has been appointed Sales Manager of the United Electric Light & Power Co., of New York City. He is a graduate of the Massachusetts Institute of Technology, Class of '96.

Mr. Wilbur J. Watson, M. Am. Soc. C. E., Citizens' Building, Cleveland, O., who recently resigned as Bridge Engineer of the Osborn Engineering Co., has taken up consulting work, with the idea of paying particular attention to the management of construction of bridges and buildings. This item will correct a statement made in this column on Aug. 15, to the effect that Mr. Watson will go into contracting.

Dr. Henry M. Payne at present General Superintendent and Chief Engineer of the Mingo Block Coal Co., of Williamson, W. Va., has been elected Professor of Mining Engineering and placed at the head of the new School of Mines at West Virginia University at Morgantown, W. Va. Arrangements have been made by which Dr. Payne will retain his present position with the Mingo Block Coal Co. in connection witht his work at the University. He will also maintain an office as Consulting Engineer at Morgantown, W. Va.

Mr. E. J. Cook, M. Am. Inst. E. E., Chief Engineer of the Cleveland Electric Ry. Co., has been elected General Manager of the Rochester (N. Y.) Ry. Co. He is a graduate of the Stevens Institute of Technology at Hoboken, N. J., Class of '86. He has been connected, since graduation, with the Edison Electric Illuminating Co., of Brooklyn, N. Y.; the Field Engineering Co., of New York City, as Vice-President and Constructing Engineer; with the Detroit Citizens' Electric Ry. Co., as Constructing Engineer; and with various electric railway interests in Cleveland. No successor to Mr. Cook has yet been named there.

Obituary.

Israel Munson Spellman, President of the Boston & Maine R. R. from 1839 to 1869, died at Marblehead, Mass., on Aug. 6, at the age of 91.

Homer Parmelee, inventor and manufacturer of the Parmelee pipe wrench, and inventor of many other boiler-shop appliances, died at his brother's home in Chicago on Aug. 12. He was born in 1818, at Middleburg, Vt.

Professor E. E. Bogue, head of the Department of Forestry at the Michigan Agricultural College, died on Aug. 19, at Lansing, at the age of 42. Prior to assuming his late position he was professor of botany at Oklahoma University.

Benjamin Franklin Hart, of Philadelphia, who for many years was Vice-President of the street-railway company operating the Seventeenth and Nineteenth Street lines, and has connected with other similar companies—all now merged in the Philadelphia Rapid Transit Co.—died recently in Philadelphia at the age of 82.

Dr. William Thomson, a physician and opthalmologist of Philadelphia, died recently at the age of 74. He was a well-known authority on testing methods for the eyesight of railroad men, and invented the "Thomson stick"—a device for making color-blindness tests with the use of colored yarns; he also wrote important works on the subject. Dr. Thomson's brother was the late Frank Thomson, President of the Pennsylvania R. R.

ENGINEERING SOCIETIES.

COMING MEETINGS.

TRAVELING ENGINEERS' ASSOCIATION.
Aug. 27-30. Annual convention at Chicago, Ill. Secy., W. O. Thompson, c/o N. Y. C. & H. R. R. R., East Buffalo, N. Y.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.
Sept. 10-12. Annual convention at Hot Springs, Va. Asst. Secy., S. C. Mumford, Detroit, Mich.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 10-13. Thirty-eighth annual convention at St. Paul, Minn. Secy., A. P. Dane, Reading, Mass.

CANADIAN ELECTRICAL ASSOCIATION.
Sept. 11-13. Annual convention at Montreal. Secy., T. S. Young, Confederation Life Building, Toronto.

LEAGUE OF AMERICAN MUNICIPALITIES.
Sept. 18-20. Eleventh annual convention at Norfolk, Va. Secy., John MacVicar, 18 Broadway, New York City.

NATIONAL IRRIGATION CONGRESS.
Sept. 23-28. Fifteenth annual convention at Sacramento, Cal.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 30-Oct. 4. Thirty-fifth annual meeting at Atlantic City, N. J. Secy., Dr. Chas. O. Probst, Columbus, Ohio.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.
Oct. 1-4. Annual meeting at Detroit. Secy., Geo. W. Tillson, 831 Ocean Ave., Brooklyn, N. Y.

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
Oct. 8. Annual meeting at Washington, D. C. Secy., Edw. A. Moseley, Interstate Commerce Commission, Washington, D. C.

RAILWAY SIGNAL ASSOCIATION.
Oct. 8-10. Twelfth annual meeting at Milwaukee. Secy., C. C. Rosenberg, Lehigh Valley R. R., South Bethlehem, Pa.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.
Oct. 8-10. Nineteenth annual convention at Atlanta, Ga. Secy., J. D. Parasey, Forest St. and Erie Ry., Cleveland, O.

AMERICAN ELECTROCHEMICAL SOCIETY.
Oct. 10-12. Annual fall meeting at New York City. Secy., Prof. J. W. Richards, Bethlehem, Pa.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.
Oct. 14-18. Annual convention of this and affiliated associations at Atlantic City, N. J. Secy., Bernard V. Swenson, 29 West 39th St., New York City.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION.
Oct. 14-16. Annual convention at Atlantic City, N. J. (See preceding item.) Secy., S. W. Mower, Southwestern Traction Co., London, Ont.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.—To celebrate the centennial of the initial run of Robert Fulton's "Clermont," 130 members of the Robert Fulton Association of this national association held a banquet at Chicago on Aug. 11. Mr. Royal D. Tomlinson, Supervising Operating Engineer of the Allis-Chalmers Co., responded to the toast "Engineers Then and Now"; Mr. John W. Lane, Editor of the "National Engineer," spoke on "Robert Fulton"; Mr. Geo. N. Carmen, Director of the Lewis Institute, responded to "One Hundred Years of Steam," and Mr. Chas. W. Naylor, Chief Engineer for Marshall Field & Co., "A Look into the Future."

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.—The next quarterly meeting will be held Sept. 9-11, at the Marlborough-Blenheim Hotel, Atlantic City, N. J. The Executive Committee meets on the 9th; a business session will be held on the 10th, and papers will be presented on the 11th. Three papers have already been arranged for: (1) "Illustrated Talk on the Work of the Structural Materials Testing Laboratories at St. Louis," by Mr. Richard L. Humphrey; "What the Cement Industry Needs in the Control and Regulation of the Cement Block Trade," by Mr. E. S. Larned; "Electrical Equipment in Cement Plants," by Mr. J. B. Porter, of the General Electric Co., Philadelphia.

INSTITUTION OF MECHANICAL ENGINEERS.—The annual summer meeting opened at the University, at Aberdeen, Scotland, on July 30. Among the papers presented were: "The Aberdeen Harbor," by Mr. R. Gordon Nicol, Harbor Engineer at Aberdeen; "Cableways Used on Shipbuilding Berths," by Mr. John M. Henderson, of Aberdeen; "Granite Quarrying in Aberdeenshire," by Mr. Wm. Simpson; "Present-day Practice in Jute Preparing and Spinning," by Mr. D. J. McDonald, of Dundee.

The members visited a number of industrial works in the city and vicinity, including the locomotive shops of the Great North of Scotland Ry., at Inverurie. At a business session Mr. Arthur Huson, of London, was elected Treasurer, succeeding Mr. Frederick Wellis, resigned; and Mr. Walter Sitt, of Bath, was elected a member of the Council to succeed the late Sir Benjamin Baker.

BRITISH FOUNDRYMEN'S ASSOCIATION.—The fourth annual convention was held at Sheffield, Aug. 6 to 8, inclusive. Officers elected for the ensuing year were as follows: President, Mr. Herbert Pilkington, M. Inst. C. E., of Chesterfield (re-elected); Vice-Presidents, Messrs. J. F. Cook, of Birmingham, and Percy Longmuir, of Sheffield; Honorary Secretary, Mr. J. E. H. Allobut, of Chesterfield.

In his opening address the President referred to the influence of the American Foundrymen's Association on American progress in founding, and predicted a like educational influence on the part of the British Association. British developments in mechanical engineering, construction work, ship and engine-building foretold large increase in the foundry industry in that country. He declared, with some pessimism, that in Great Britain there was a tendency to cling to antiquated methods in foundry practice, which it was the duty of the Association to break up.

Papers which were presented were: "Practice and Theory," by Mr. Percy Longmuir, a paper devoted to cupola practice and the metallurgy of iron; and "The Foundryman, Past, Present and Future," by Mr. W. H. Sherburn, of Warrington, whose object was to further the "human factor" in the work of foundrymen.